

Chapter VIII

Implementation and Adaptive Management

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Implementation and Adaptive Management

This chapter is intended to provide a view of how a selected management option may be instituted over the longer term -- including the Phase II planning called for in the Overview and Summary section. If one of the options is chosen for management action, it may be executed by alternative means than those suggested herein. We do believe, however, that the principles put forward are sound.

We expect that the forest management option selected by the President will lay the groundwork for the development over time of a regional economy in the Pacific Northwest that is simultaneously ecologically sound, economically sustainable, and socially responsible. Implementation of the selected plan will require several actions by the relevant resource agencies. These actions include implementing an adaptive management process within the framework of existing laws and policies. This process includes planning, monitoring, evaluation and adjustment, research, and following an implementation strategy. Full participation -- active collaboration -- will be required of many state and federal agencies, tribes, industrial and nonindustrial landowners, conservation groups, and other publics.

President Clinton and others at the Forest Conference stated the basic requirements for an acceptable plan for future management of forests and rivers of the Northwest:

"Never forget the human and economic dimensions of these problems"...This requires people and community involvement in guiding change.

"Protect the long-term health of our forests, our wildlife, and our waterways"....This requires setting desired future ecosystem conditions and developing ecosystem management as an approach to getting and keeping ecosystems in those desired conditions.

"Our efforts must be, so far as we are wise enough to know it, scientifically sound, ecologically credible, and legally responsible"...This is an essential component of any comprehensive conservation strategy.

"Produce a predictable and sustainable level of timber sales and nontimber resources that will not degrade or destroy the environment"...This also should be an objective of a comprehensive conservation strategy for public forest lands in the Pacific Northwest.

"Make the federal government work together and work for you"...This requires policies and cooperating institutions suited to the task.

In Chapter 2, a multiphased approach to the shift to ecosystem management was described. In Phase I (this report), an array of 10 options was developed that would provide the "backbone" of an ecosystem management approach in which there was the achievement of a functional system of Late-Successional

and Riparian Reserves that would provide for an interactive network of such forests and the protection of habitat for the northern spotted owl and marbled murrelet (both of which are listed as threatened) and for spawning and rearing habitat of at-risk fish species. Phase I ends with the selection of an option for management and the completion of the associated Environmental Impact Statement.

In subsequent phases of planning the concept of ecosystem management should be integrated across Forest Service and Bureau of Land Management lands. This should assure a coordinated approach to achievement of ecosystem management on federal lands, and help determine if the concept of ecosystem management can be extended beyond the boundaries of federal lands. It is in this chapter that the subsequent aspects of implementation are addressed.

Our Current Situation

In this chapter, we briefly summarize some of the prevailing attitudes and perceptions of people affected by forest management in the Pacific Northwest (for details, see Social Assessment of the Options), the current state of these ecosystems and their management, and the status of the federal institutions responsible for their stewardship. Our goal is to provide a perspective of the complexity of these issues, including some of the positive and negative aspects associated with these issues, which lead to identification of changes that are needed if agencies are to move forward from their current situation. In subsequent sections of this chapter we will establish the setting for implementation, identify the research and monitoring approaches required for adaptive management, and lay out the framework for implementation that needs to be addressed by agencies in both the short and long term if our effort is to be successful.

People and Communities

The complexity of issues in the Northwest is characterized, in part, by the diversity of opinion over how much of the public forests should be converted to young, even-aged forests designed to produce products for human use and how much should be retained in late-successional and old-growth forests. Regardless of the position individuals take in this debate, it has been made clear time and again that people care about the environment. This commitment was articulated at President Clinton's Forest Conference, where people representing forest-dependent communities, industrial and nonindustrial landowners, government scientists, environmental groups, and academicians recognized a need for change. These representatives wanted the current management situation in the region to end and were prepared to work toward creating a new vision for forest management in the Pacific Northwest that was biologically sound, economically sustainable, and socially acceptable. Unfortunately, their visions of the direction of change diverged widely. The balance between the national interest, as articulated in law, and regional and local interests is particularly difficult to resolve.

In the current situation many people are dissatisfied with the decisionmaking processes used by the federal agencies to manage lands. For example, many participants (including environmental and timber interests) consider the planning process currently used by the Bureau of Land Management and Forest Service to be ineffective at incorporating public views. People, particularly those directly affected by these decisions, often feel their opportunity to be involved throughout the development of plans is too limited and occurs

too late in the process. Although substantial changes can, and often are, made by agencies following public review, people often regard the functional nature of their involvement as "tokenism" (Mohai 1987). Yet, others who are well informed about the planning process feel that their opportunity for involvement is excellent and the agency response is gratifying.

Rural and urban communities throughout the Pacific Northwest depend on federal forest lands. The relationships between these communities and the federal lands are complex, ranging from obvious employment linkages to more subtle issues of culture and self-identity. Management choices on the federal lands affect the lives of individuals in these communities positively and negatively, and may affect the futures of entire communities.

A commonly heard argument is that Congress and the federal land management agencies have made a series of explicit and implicit promises to the forest-dependent communities in the region. Terms such as "sustained yield," policy objectives such as "community stability," and revenue-sharing formulas such as the 25 percent Fund Law for Forest Service lands and the 50 percent payments from the Bureau of Land Management's Oregon and California (O&C) railroad lands can all be used to support such an argument. However, some contend that the federal agencies have not fulfilled their commitment to support the communities because the areas open for traditional use, such as timber harvest and motorized recreation, have been reduced.

No general agreement exists on what responsibility the federal land management agencies have toward forest-dependent communities. Most people appear to agree, however, that the politics that currently characterize such management are divisive. The institutions that have been trying to craft policy (agencies, courts, and Congress) have all struggled to divide the land base so that every interest gets a piece, hoping to meet everyone's needs. That distributive notion is not compatible with the holistic aspects of ecosystem management, nor has it furthered the sense of community in the region. We suggest this situation may be, at least partially, rectified through implementation and the process of adaptive management.

Ecosystems and Their Management

The forested ecosystems of the Pacific Northwest have been altered by past land management practices carried out to implement public policy. Historical and recent emphasis on commodity production has resulted in habitat fragmentation and a significant reduction in the amount of old-growth (200 years and older) forests in the region. Changing social values, coupled with a greater scientific understanding of the effects of past management practices on fish and wildlife, have resulted in much closer scrutiny of the consequences of forest management practices on public lands. This -- coupled with the listing of species such as the northern spotted owl and marbled murrelet, and petition to list Umpqua River sea-run cutthroat trout -- has resulted in much stronger environmental efforts to protect the remaining old-growth forests.

During the past 2 decades, intensive research has been conducted on old-growth ecosystems and many associated species and is continuing. Of these, the threatened

northern spotted owl has received most of the attention by both researchers and the public. During this period there also has been an unfortunate and polarizing "owls versus jobs" debate. What many do not understand, however, is that there are other listed or at-risk species (e.g., marbled murrelet, fish stocks) or processes (e.g., old-growth forest ecosystem processes) about which more information would enhance our ability to address their conservation. This recognition of inadequate knowledge to make fully informed decisions extends across all renewable natural resource areas and should not be taken as a reason not to make decisions on the basis of the knowledge that does exist. This lack of information contributes to the debates among scientists and advocates on both sides of the issue regarding the degree to which logging or other forest management activities should take place on federal forest lands. This is a primary reason that the staged approach described earlier has been applied in which the first phase lays down a general strategy and the subsequent phases involve refinement based on additional study, monitoring, adaptive management, and analysis.

In contrast, in situations where loss of habitat has long been recognized, little has been done to reverse the trend. Degradation of riparian areas and declining salmon stocks are a notable case. Restoration efforts have long been ignored because of inadequate funding within the management agencies or denial that impacts were occurring. Consequently, agencies now find themselves in the midst of a biological and management crisis that needs immediate attention. In the short term, while the necessary levels of protection and restoration of these systems are identified and initiated, agencies are likely to lose a great deal of management flexibility on federal forests.

If an approach to forest management that recognizes conservation needs is adopted on federal lands, most of our biological options for management can be retained for the future. To accomplish this, however, agencies will need to develop and implement interdisciplinary efforts that address the diverse array of conservation and management issues that occur at the watershed, province, and regional scales. To achieve the vision of ecosystem management we must plan, achieve, and maintain not only the ecological objectives identified for those systems, but fully integrate the socio-economic aspects as well. Humans are a functional and integral part of managed ecosystems and successful federal land management requires the human dimension to be fully integrated into the process.

Federal and state agencies (Salwasser 1990; Overbay 1992) and scientists (Franklin 1989; National Research Council 1990; Lubchenco et al. 1991; Stankey and Clark 1992; Society of American Foresters 1993) are in the midst of formulating and implementing ecosystem management concepts. As a concept, ecosystem management focuses land management on the well-being of ecosystems, examines ecosystems at multiple spatial scales and ownerships, addresses resource including socio-economic issues at the appropriate scale, encompasses conservation and restoration activities, and accepts that commodity outputs are inextricably linked to the health of the ecosystem. This approach focuses on entire biophysical systems (including landscapes and regions) and attempts to maintain natural ecological processes and functions. A system of reserves may be an integral part of ecosystem management, depending on objectives. In other areas, active management (e.g., silvicultural practices, ecosystem restoration programs) to achieve different objectives is

also a part of this strategy.

Unfortunately, there is a long way to go before ecosystem management is in practice. Traditional research and management of wildlife populations, for example, have been species-specific and limited to a narrow range of the biological diversity found in our forested ecosystems. Ecosystem research and landscape ecology are similarly in an early stage of development. The information generated by scientists and applied by managers has been aimed more at the stand management level or at the level of habitat relationships of individual species. As we move into ecosystem management, research needs to be reoriented into a broader community view and at a broader landscape scale.

While we strive to develop a comprehensive ecosystem management perspective, we also need to recognize that this approach may create conflicts with the management of particular species or with other resource management objectives, and may affect or involve private lands. For example, some uncertainty regarding the viability of certain components of old-growth ecosystems stems partly from an incomplete understanding of the species and processes that occur there. A consistent information and an aggressive adaptive management philosophy can help reduce this uncertainty. Implementation of ecosystem-based management is not a short-term process with a fixed goal, but rather a dynamic process that requires continuing evolution, commitment, and involvement.

Institutions

From the 1950's through the early 1990's, management of public lands focused increasingly on outputs (e.g., board feet, visitor days) with environmental considerations treated as constraints. Environmental directives came from Congress through laws such as the Federal Land Planning and Management Act and National Forest Management Act, while commodity output levels (i.e., allowable sale quantity of timber) was set through the annual appropriations process (Figure). Our current management gridlock reflects in part the federal judicial branch's determination that the agencies had not satisfactorily complied with environmental laws -- most specifically the procedural requirements of such laws as the Endangered Species Act and the National Forest Management Act. This gridlock plus a greater scientific understanding of the impacts of past management practices led the Forest Service and Bureau of Land Management to move toward ecosystem management as a guiding principle.

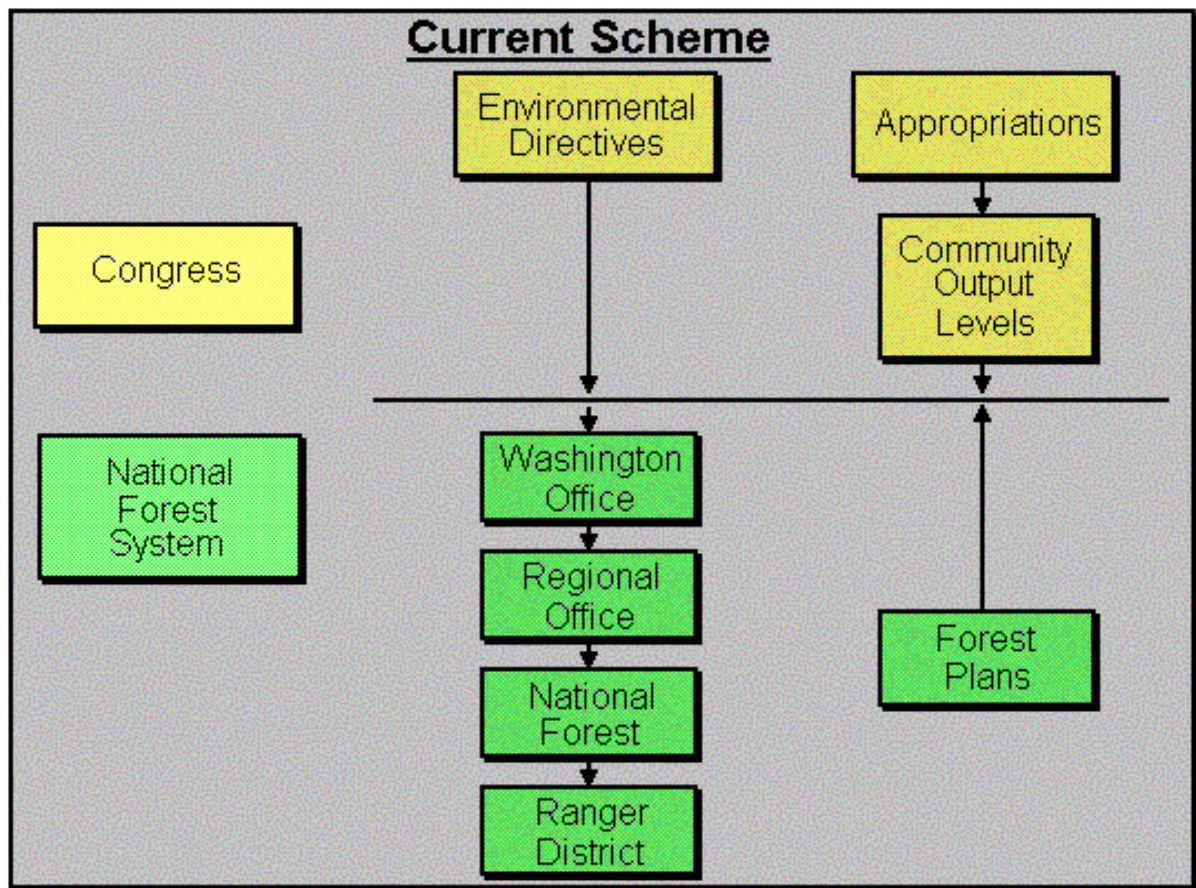


Figure 8-1. System used for defining environmental directives and timber output levels (targets) that evolved in the 1970-1980's.

Land management in the Pacific Northwest is in a period of profound change, including development of ecosystem management, regional conservation strategies, and silvicultural practices. Regional conservation strategies, such as those being proposed in this effort, can have major influence on the management of watersheds and forest stands (Figure) by determining management objectives and land allocations (e.g., reserves for old-growth species), management of lands outside reserves (e.g., riparian buffers), and analysis procedures (e.g., watershed analysis). Landscape and watershed approaches to ecosystem management have involved development of ecosystem-based riparian management systems and watershed analysis (see Ecosystem Management) to identify critical processes, sites of potential management impact, and restoration opportunities. In planning, forest/district and project scales of analysis and decisionmaking must shift to a more biologically significant regional and watershed scale.

A major aspect of this change is the shifting perspective on allowable sale quantity, the estimated level of timber sales from federal lands. Allowable sale quantity has been a major currency of forest management policy (Figure), a basis for evaluation of accomplishments of management units and individuals, and a focal point of distrust

between land management agencies and the public, and between biologists and managers within land management agencies. Allowable sale quantity may be an outdated concept; it runs counter to the goals of ecosystem management and it will be a shifting target under the incremental planning context of adaptive management described in this chapter.

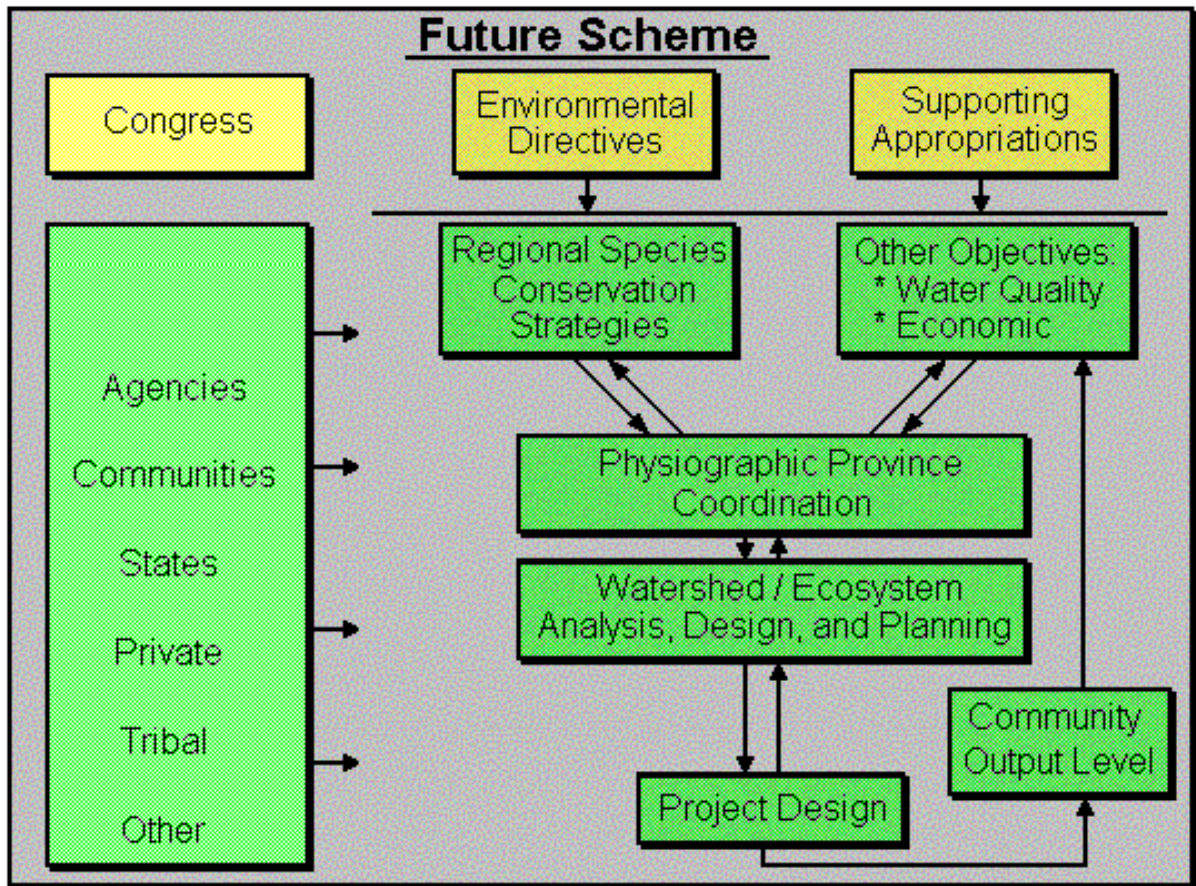


Figure 8-2. Schematic diagram of potential future relations among environmental directives and appropriations, implementation of conservation strategies at different scales, and project planning. In this scheme, commodity output is shown as a result of the process rather than a driving force.

With the increased emphasis on conserving biological diversity and ecological function within old-growth forest ecosystems, land management and regulatory agencies struggle to redefine their role as stewards of public lands. Federal leadership appears ready for a change. Fundamental change, however, will not be easy. Strong leadership will be needed at all levels of government and in the public to successfully implement whatever forest management program is developed.

Historically, the land management and regulatory agencies have not worked together

effectively, mainly because they lack shared missions and objectives. They have worked independently, with limited collaboration or coordination. Where coordination has been attempted, data sharing and communication are difficult because of differences in terminology, data bases, and their interpretation. Agency planning efforts have often not been ecologically based or developed across the appropriate spatial scales or agency boundaries. Administrative, programmatic, and budgetary structures within the agencies have also impeded attempts to take interdisciplinary approaches.

On top of these problems, lawsuits and confrontations between land management and regulatory agencies have created an environment hostile to proactive change or collaboration. Within agencies, some researchers suspect that land managers do not support their efforts and circumvent recommendations regarding threatened, endangered, and at-risk species or ecosystem protection. Conversely, some land managers believe research scientists have usurped their management decision role by narrowly focusing scientific interests so as to severely restrict management options.

Altogether, the result is delay, miscommunication, and conflict both within and between agencies, and between agencies and the public. A concerned public ends up confused and mistrusting, believing that the agencies are out of touch with contemporary societal values. To successfully break this gridlock and develop a more trustful environment for all parties, the agencies must establish a common vision and shared missions for managing public lands in the Pacific Northwest. This must be based on extensive interagency coordination and an interdisciplinary approach as we move toward ecosystem management.

Policies

The United States has some of the most comprehensive environmental legislation in the world. But comprehensive environmental protection requires a great deal of political commitment and a strong scientific basis. The Endangered Species Act, for example, calls not only for the protection of threatened and endangered species but also the habitats upon which they depend. The National Forest Management Act and the Federal Land Planning and Management Act call for an interdisciplinary, integrated approach to physical, biological, economic, and other sciences. But the policies directing federal land management in the Pacific Northwest have not provided for the diversity of values identified in these acts and have instead focused principally on commodity outputs. This has resulted in federal regulatory agencies, such as the Fish and Wildlife Service, and public conservation groups challenging Pacific Northwest land management agencies both through administrative processes and in the courts, many of which have been successful.

Such challenges shift the attention from the larger old-growth forest ecosystem issue to the legal issues surrounding the protection of selected species such as the northern spotted owl. The conservation and management of old-growth ecosystems is a far more complex issue than the single species (owls versus jobs) debate and subsumes many other issues that have since emerged (e.g., marbled murrelets, declining salmon stocks, and degraded riparian areas). Federal agencies must refocus their attention back to the broader level of the ecosystem, while at the same time recognizing that these lands serve important social functions.

This refocusing of attention requires society and the federal agencies to seek a shared vision, common policies, and collaborative management. Where agency policies and regulations are inconsistent with this new vision, they should be changed. It is not possible for the Bureau of Land Management and the Forest Service to maintain the high timber harvest levels established for them in the past and simultaneously protect fish and wildlife species, and the ecosystems upon which they depend. In addition, the regulatory agencies must become more involved in the planning process to effectively help land managers meet new objectives.

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Vision for Managing Ecosystems

To chart a useful path out of the present gridlock it is essential to look ahead to where we believe people, institutions, ecosystems, natural resource management, and policy should be in future decades, a step that is critical to the successful implementation of the process described in this chapter. A vision of future ecosystems is implicit in the conservation strategies described in this document and that vision varies dramatically between the options presented. A vision of the future under the options selected should be developed. Such a vision of the future condition of the federal forests should then guide managers as they move toward that goal.

The options described in this report focus largely on critical conservation strategies for selected species of fish and birds and for late successional/old-growth forests. But the overall management of ecosystems involves issues broader than these conservation strategies--namely, the social context. A sound conservation strategy has little prospect of success in saving threatened species and breaking a gridlock in a social context of conflicting values and distrust. Therefore, this discussion begins with an implementation strategy for future ecosystem management with a focus on the human dimension.

The Human Dimension

The relationship between people and environment is the focus of several academic disciplines, and there is no way to capture completely the richness of their findings in this chapter; we recommend Social Assessment of the Options for additional discussion. Although the purposes of the federal land management agencies are to carry out their statutory responsibilities, the agencies are important links between the general population and the federal lands. The agencies should be able to help society understand the federal lands and the choices for managing them.

A major challenge facing the agencies is the continual refinement of their relationship with citizens. The agencies must balance two competing tenets of faith that are fundamental to the American psyche: (1) the belief that citizens should have a voice in the public decisions that affect them and (2) the belief that problems have rational or technical answers. How can we craft natural resource policy using the best science, which by definition becomes increasingly complex over time and is understood by a fairly select group of scientists, while at the same time involve the broadest segment of the citizenry in the process? How can society balance the politics of expertise with the politics of inclusion? Pierce et al. (1992) stated that this balance has become more precarious in recent years and referred to it as the "technical information quandary." They argued that "forceful and persisting public demands for participation and a growing complexity of public policy issues are fundamental aspects of post industrial societies."

Considerable evidence shows that the techniques used by the federal agencies to involve their publics have not succeeded in a meaningful manner (USDA Forest Service 1990, U.S. Congress Office of Technology Assessment 1992). The public/agencies relationship is unlikely to improve if people only are at the periphery of an ecosystem management model that is crafted by experts in isolation. The Forest Conference offered the people of the region a voice, a chance to state their cases forcefully and honestly, and thus become part of the policy-making process, not merely constraints upon it.

In the future, forest management must require agencies and the public to work together. We know that we are unlikely to come to perfect agreement about these lands -- they are too valuable, the issues are too complex, our interests are too varied, the biological knowledge too imperfect, and our value differences too apparent. However, if we cannot learn to manage adaptively, gridlock and paralysis will continue and both the biological and social dimensions of the federal lands will suffer.

New forums such as the Forest Conference will need to emerge as social values are more meaningfully incorporated into federal land management. Stankey and Clark (1992) reviewed the Forest Service's New Perspectives program and found that "there is a lack of non-threatening environments in which debate and discussion of critical issues facing resource managers, citizens, and others can occur." A number of techniques can promote meaningful discussion, such as transactive planning (see Carroll and Hendrix 1992). It is not important that any particular technique be used, but that the process be inclusive, flexible, and stress learning as opposed to just fact finding.

Results of inventories of natural resource collaborations offer some insight. Bingham (1986) identified over 200 cases on natural resource/environmental negotiation, primarily in the Northeast. Daniels et al. (1993) identified 56 instances of collaborations regarding natural resources in the Northwest since 1990. Johnson (1993) synthesized a series of nine case studies into an explanation of how to move natural resource policy in the Pacific Northwest beyond polarization. These inventories indicate a tremendous interest in collaborative rather than agency-centric approaches to public resource management. This interest may have arisen from the recognition that ecosystem management must cross land-ownership boundaries and that the more traditional venues for decision making appear to be at impasse. This collaborative approach is critical to the success of the adaptive management strategy envisioned here.

We must recognize that collaborations, while an important source of goals and innovation for federal lands, cannot foreseeably replace the land management agencies. Well-organized, adequately funded agencies are society's major tool for achieving its goals on federal lands, for monitoring the impacts of management, and for leading the discussion of what our options are for public lands. The federal agencies have been entrusted with decision authority through Congressional action; they must be given the wherewithal and freedom to make those decisions.

Desired Ecosystem Conditions

The actual future of the Pacific Northwest landscape is impossible to predict--it will be the product of social, political, and ecosystem understanding and adaptive management procedures. However, given the current charge of moving to ecosystem management in the context of present law, the desired future condition of federal forest and riverine ecosystems of the Pacific Northwest should incorporate levels of biotic diversity, ecological processes and functions, including habitats, that sustain viable populations of native species as well as the productive capacity of the ecosystems. These visualized conditions are explicit in laws directing federal land managers and implicit in the standards and guidelines of the options described in this document. To attain these goals, the landscapes must retain their inherent dynamic nature, including resistance and resilience to disturbance by wildfire, flood, insect attack, climate change, and other internal and external agents of change; maintain their productive capacity; contain a distribution of forest age and structural classes and stream environments that provide habitat for a full range of native plant and animal species; and be managed in an environment of interagency and public trust and socio-economic well-being. A particularly challenging aspect of long-term management of ecosystems and biological diversity, given present law, is recognition that natural processes of evolution lead to gain and loss of species.

One vision for the future of federal forests is that significant portions of the landscape be in old forests (e.g., older than 80 years). Areas of old forest should be well distributed geographically, considering both north-south and elevation gradients to accommodate the types and richness of biotic diversity. Some of these old forest areas could be in reserves, areas of long-rotation cuttings, or areas of perpetual uneven-aged management.

Reaching this condition requires a path that accommodates changing society, shifting societal values and expectations, and growing understanding of ecosystems. This path will likely include ecosystem

reserves (places to learn about natural systems and to preserve management options in the face of limited knowledge) and explicit learning processes (research, monitoring, watershed analysis and ecosystem planning procedures, and adaptive management programs). Ecosystems do not stop at artificial borders. All lands, public and private, are important to supporting and maintaining healthy, functioning ecosystems. This requires close collaboration among federal agencies, nonfederal landowners, and the public. Conservation strategies and adaptive management could result in quite different future landscapes. The adaptive management process is intended to help us move in the appropriate direction.

Ecosystem Management

We recognize that ecosystem management as a term and as an agency or interagency agenda may be ephemeral, as similar terms and management initiatives have been in the past. The underpinnings (e.g., empirical knowledge, ecological theory, social expectation, funding, law, available tools, etc.) of natural resource management are in rapid flux and deal with imprecise concepts, such as ecosystem management and sustainable development. Ecosystem management as a guiding principle, focuses attention on ecosystem well-being in senses consistent with Congressional expressions of social values. Furthermore, the concept directs the attention of land managers and others to understanding ecosystems and developing appropriate site-specific management. A potential downfall of ecosystem management as a directive is that it could downplay the significance of people in setting management objectives and procedures, and that it could become viewed as a fixed set of practices or objectives that cease to evolve with new information. To avoid this, agencies must function in an open, learning mode; ecosystem management is useful to the extent that it fosters a learning attitude within agencies. It is in this spirit that we use the term in this chapter.

Conservation strategies, a component of ecosystem management, will have a profound effect on near-term management of the Pacific Northwest public forest lands. The conservation strategies addressed by the Scientific Assessment Team (Thomas et al. 1993), and by many of the options evaluated in this document, involve layering relatively independent management schemes to accommodate northern spotted owls, old-growth ecosystems, marbled murrelets, and selected fish stocks (Figure). The next step is to assign multiple roles to individual land allocations in an overall conservation strategy. This process would evaluate questions such as the extent to which Key Watersheds for fisheries protection can also provide habitat for owls and murrelets. This step leads to development of a single conservation strategy with multiple phases to accommodate the various species and ecosystems (e.g., riparian and old-growth) of interest. The improved integration across objectives gives a better balance between ecological and economic objectives. One option (Option 9) is an initial attempt at describing this type of approach (see Option Development and Description).

A multiphase conservation strategy ultimately could give way to more ecosystem-oriented management (Figure). Conservation strategies emphasize single species and maximum care of the best remaining habitat. Ecosystem management, on the other hand, works with present conditions and an understanding of natural ecosystem patterns and disturbance regimes to direct ecosystems to a potentially different future. Getting away from single-species management will require substantial restoration and adaptive management actions. These activities will accelerate the transition from conservation to ecosystem management.

An important element of managing the future landscape of the Pacific Northwest will be an integrated understanding of ecosystems across ownerships--federal, state, and private. Streamflow and species of fish, wildlife, and other organisms know no interjurisdictional or ownership boundaries. Consequently, increased ecological knowledge, concern with environmental protection, and an ecosystem approach to management will foster interownership cooperation and ultimately will lend improved efficiency in balancing ecological and economic objectives. The Clean Water Act, for example, makes state agencies responsible for a broad range of programs to protect water quality. These programs apply to waters that

cross ownership boundaries within a watershed.

New technologies also foster interownership cooperation. Satellite remote sensing lets us observe spatial patterns and time trends of forest cutting and regrowth (Figure). Other technologies, such as landscape visualization and decision support systems, will permit public examination of past and potential management and its consequences on a mix of ownerships. All this links society, policy, land management, and science.

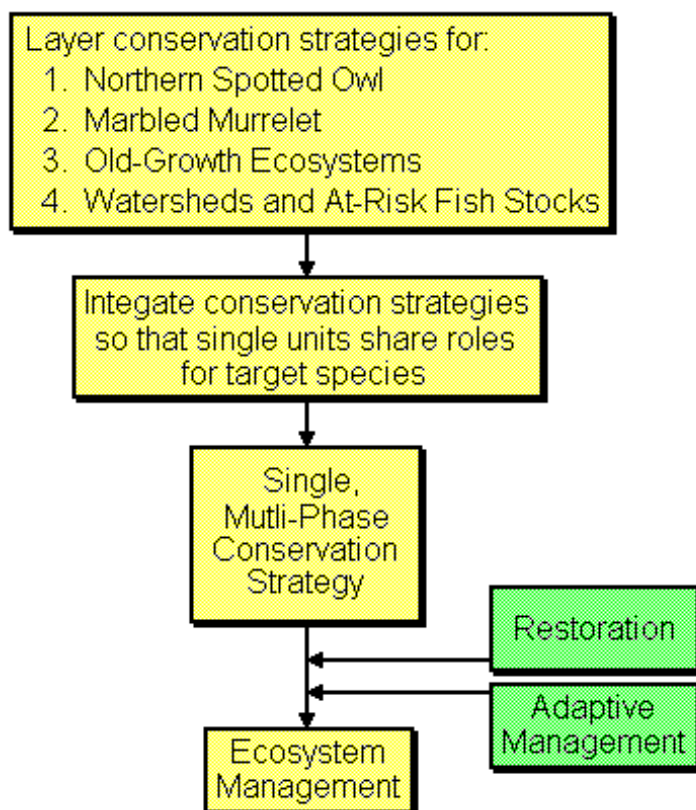


Figure 8-3. Conceptual diagram of the transition from our current "layering" approach using largely species-specific conservation strategies, through a single, multiphase strategy to an ecosystem-based, rather than species-based system of management.

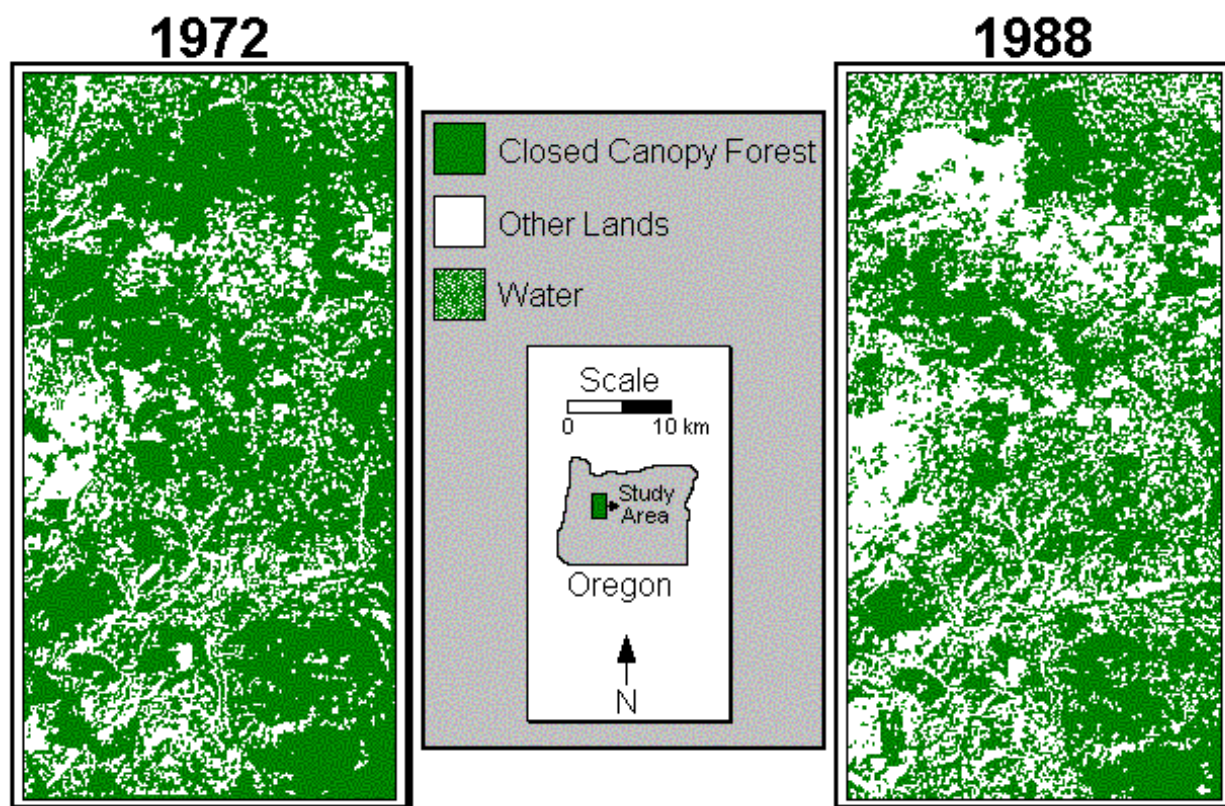


Figure 8-4. Map of closed canopy (natural and managed stands generally older than 30-40 years) and other lands (clearcut, younger plantations, rock outcrops, etc.) in the central Cascades of Oregon. Willamette National Forest covers roughly the central and eastern thirds of the area. Wilderness areas are evident in the 1988 image in the southeastern corner (Three Sisters) and top center (Middle Santium). Other extensive patches of closed canopy forest include another wilderness area (Menagerie), H.J. Andrews Experimental Forest, and Hagen Research Natural Area in the central 50 percent of the map. private industrial lands are located predominately in the western half of the image. (Image prepared by F. Bradshaw and W. Ripple).

Watersheds as Basis for Management

Implementation of effective ecosystem management will require ecosystem planning as a multiscale, hierarchical process designed to deal with multiple values, scales, and disciplines (Table). Central to this process is the concept that watersheds represent a physically and ecologically relevant and socially acceptable scale for managing forest resources. Watersheds are an appropriate spatial unit for implementing ecosystem management because they link regional conservation strategies for terrestrial and riparian species, provincial and landscape objectives, with project implementation.

Many key physical processes are best understood at a watershed basis (i.e., movement of water, sediment, wood, and consequent effects on channel structure and habitat), and understanding these linkages is essential for understanding onsite and offsite effects of human activities. Recognizing watersheds is essential to achieving objectives for organisms whose habitat needs cross ownership boundaries (e.g., marbled murrelets) or that use different habitats over their life cycle (e.g., fish). Incorporating watersheds into conservation planning for species that are not watershed-based allows

coordination and flexibility in developing management options that influence all species, and may offer opportunities for creative solutions that meet multiple objectives.

Finally, watersheds provide a rational and effective spatial scale for citizens to participate in natural resource decision making. Watersheds represent a natural demarcation of geography that encompasses a wide diversity of ownerships, issues, and viewpoints. Many of the best examples of community-based resource planning -- the Applegate Project in southern Oregon and the Mattole and Redwood Community Watershed Associations in northern California -- are organized on a watershed basis.

Spatial Scales

Ecosystem planning needs to be conducted at four spatial scales: regional, province/river-basin, watershed, and site (Table). It should be understood that management activities continue under plans in force while new planning takes place. The region, for the purposes of this report, is the Pacific Northwest, encompassing the range of the northern spotted owl. Provinces are areas of common geology, climate, and physiography in which technical information from one area can be widely extrapolated. Their scale is comparable to that of major river basins, such as the Klamath, Umpqua, or Willamette, or groups of small coastal watersheds with similar beneficial-use and resource-value issues. Provinces may overlap several river basins, and river basins may contain parts of several physiographic provinces. Watersheds are sub-basins of 10-200 square miles and are the scale at which watershed analyses are conducted. Sites are areas of variable size but typically range from tens to hundreds of acres, where specific activities take place, including timber harvest, habitat restoration, silvicultural treatments, and road construction.

At each scale, analyses describe human needs, environmental values, and important watershed and ecosystem functions. Information collected at the broader spatial scales (regional and provincial) guides analysis and development of management options at the finer scales (watershed and site). Conversely, information collected at the finer scales provides feedback on cumulative effects at the larger scales.

Issues to be Addressed at Different Scales

Scale	Approximate Size (sq. mi.)	Examples	Issues Addressed
Regional	10,000-20,000	Westside forests, owl region	* Regional conservation strategy for species and ecosystems; * Standards and Guidelines for managed lands; * Public participation in shaping regional strategies; * Water Quality Objectives.
Province/River Basin	1,000-10,000	Oregon Coast Range, western Cascades, Klamath River Basin	Beneficial Uses: * Large-scale water development (i.e., hydroelectric, irrigation); * Dominant physical processes (i.e., mass-movement types, hydrologic regimes); * Dominant vegetation patterns and disturbance processes (i.e., fire, insects); * Historical land-use patterns; * Distribution of at-risk/T&E species; * Refinement of Standards and Guidelines; * Public participation in shaping strategy.
Watershed	10-100	Augusta Creek (Willamette NF) Elk River (Siskiyou NF)	* Landscape-specific physical and biological processes; * Merging management objectives for upland and riparian; * Incorporating public expectations for water management options; * Designing monitoring and restoration strategies.
Site	0.01-0.1	Individual timber sales; restoration projects	* Implementing management options; * Implementing monitoring.

Table 8-1. Issues to be addressed at different at different scales in ecosystem planning.

Regional Scale

Information from the regional scale (Table) identifies important beneficial uses, resource values, and economic issues and is used to evaluate how resources in a particular river basin or watershed influence resource values throughout the region. In many cases, regional issues transcend river-basin or watershed boundaries and may constrain management options at these scales. For example, habitat protection for threatened and endangered species may be established as a regional network, based on region-wide habitat conditions or availability of refugia. However, there often is insufficient information at this scale for it to be appropriate for project planning.

Province/River Basin Scale

At the province/river basin scale beneficial uses and ecosystem values for large river basins and physiographic provinces are analyzed, and interagency and interownership planning is coordinated. Key issues at this scale include distribution of threatened and endangered species or stocks, patterns of historic and current resource use, water quality issues, identification of communities at risk, and management of multiple reserve systems. The context of river basins with respect to other large basins and intrabasin/regional issues that cross drainage basin boundaries are identified. The distribution of key physical processes influencing species and habitats are mapped, as are the location of Key Watersheds and ecological reserves. Watersheds are prioritized for analysis, and the results of watershed analyses are synthesized to assess provincial and regional cumulative effects.

Watershed Scale

The most comprehensive and detailed analyses are conducted at the watershed scale. Watershed analysis is a process for collecting information and implementing ecosystem management at the scale of 10-200 square mile watersheds and is intended here to characterize planning for terrestrial as well as riparian species. This systematic procedure (see Aquatic Ecosystem Assessment for details) gathers information on ecological processes to help characterize and meet specific management and social objectives. This information then guides management prescriptions, sets restoration priorities, and reveals the most useful ways to monitor environmental changes. Watershed analysis is the method by which issues and concerns developed at regional, physiographic, and large river basin scales are refined and applied to specific landscapes, and is critical to future project planning.

Watershed analysis plays several roles under the options presented in this report. It provides information to drive planning, including the identification of issues, processes, and constraints that are likely to influence land use activities. It also is required to adjust boundaries of riparian and late-successional reserves. Watershed analysis provides a functional mechanism for coordinated evaluation of fish, hydrologic, and geomorphic linkages and upland landscape patterns, wildlife habitat, and silviculture.

Watershed analysis is both an analysis procedure and the first step in watershed planning. Fully developing and implementing watershed planning as a coherent stratum of ecosystem planning will require experimentation, learning, and the perspectives of a wide circle of individuals and disciplines, including planners, resource specialists, managers, sociologists, and scientists.

Site Scale

Finally, at the site scale of 10s to 100s of acres, individual projects are planned and initiated. These may include timber sales, silvicultural treatments, restoration activities, and so on, and are designed to be compatible with information developed in the watershed-level analyses. Monitoring activities are also planned and initiated at this scale.

Adaptive Management

A formal process of adaptive management will be required to maximize the benefits of any option described in this report and to achieve the long-term objective of ecosystem management. The entire effort must be supported or driven by multivalue inventories, research and development, experience, new policy, regulations and legislation, and shifts in goals and objectives.

Adaptive management is a crucial element of any ecosystem-based strategy. It is based on a continuing process of action based on planning, monitoring, evaluation, and adjustment (Figure). This process, if adequately designed and effectively implemented, will enable managers to determine how well their actions meet their objectives and what steps to take to modify activities to increase successes. This section includes recommendations designed to ensure effective implementation of whatever management option is selected.

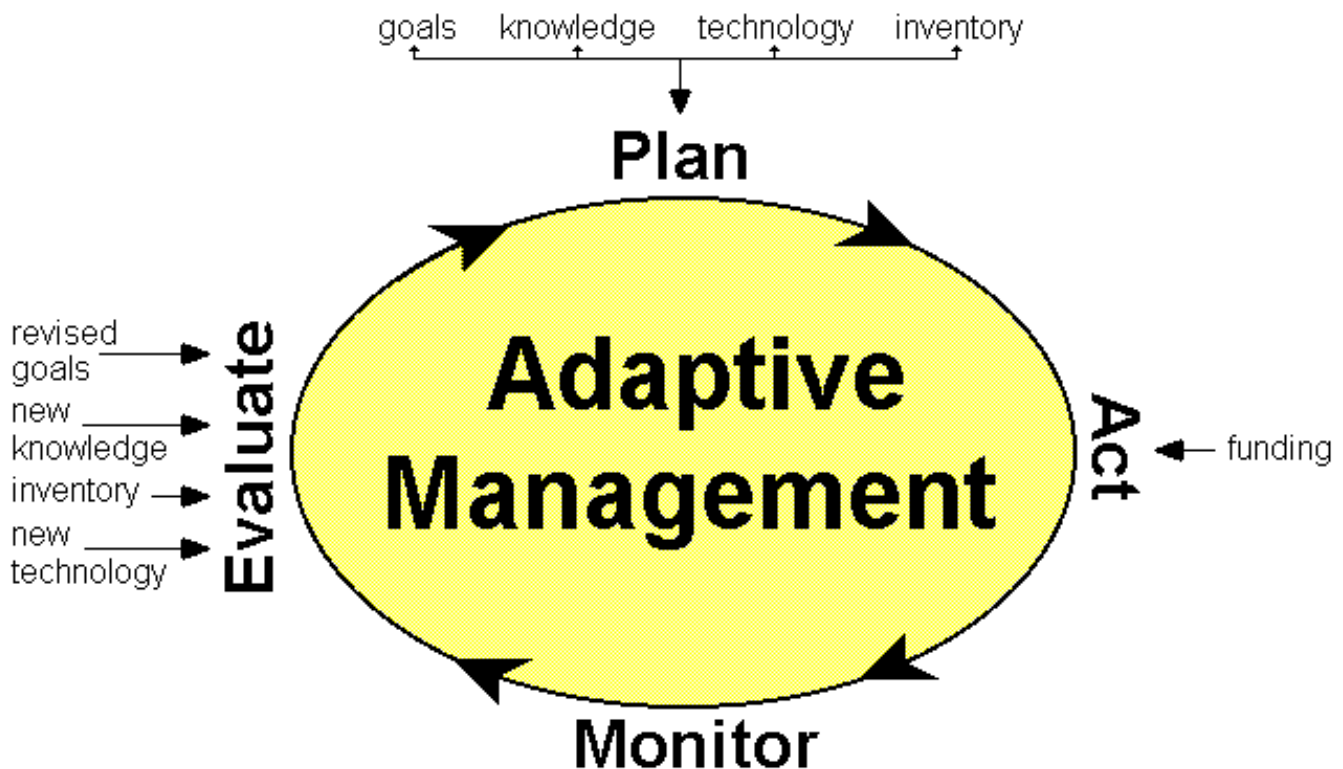


Figure 8-5. Process of adaptive management.

Because adaptive management leads to change in direction as new information becomes available it ideally will improve or refine standards and guidelines over time. To attain those improvements and refinements, an adaptive management system might logically include:

A legal, policy, and regulatory foundation.

Review of the process and oversight.
Organizational accountability.
Specific mechanisms to ensure all components are effectively implemented.
Effective information handling capabilities.
Adequate funding.
Multiagency linkages.
Public support and participation.
A research and monitoring program.

Examples of questions related to forest management strategies developed for the Pacific Northwest that would be addressed by adaptive management include:

When and how would it be appropriate to alter boundaries of Late-Successional Reserves?
When would it be appropriate to change riparian habitat management strategies?
What management activities will be appropriate in Late-Successional Reserves?
Are the management strategies in the Matrix meeting intended objectives?
Are thinnings in Reserves producing anticipated results?

Recommendation: The federal resource and regulatory agencies in cooperation with public and private interests should develop an adaptive management process that includes multiagency and independent oversight and evaluation. Oversight issues might include assessment of:

Adequacy of incorporation of new social, biological, and physical information.
Change in management direction based upon new information.
Public involvement.
Quality of monitoring and inventory systems.
Evaluation of cumulative effects.
Barriers to effective adaptive management.
How well management addresses the standards and guidelines adopted with the forest management strategy selected.

Planning

Current federal resource agencies' planning processes have not always produced legally, scientifically, or socially defensible products. Furthermore, the array of planning scales has been too limited for addressing current resource issues. A new, or greatly modified, planning process would support effective implementation of the options and objectives described in this report. Current planning processes should be evaluated for:

Context - Is it consistent with ecosystem management?
Scale - Is planning done at the appropriate scales? Are alternatives presented to the public at all scales?
Action - Is provision made to ensure the plan is actually implementable on the ground?
Nonfederal lands - Is the role of state and private lands analyzed and described?
Public involvement - Is it adequate, meaningful, and participatory?
Science and technology - Are there adequate mechanisms to ensure incorporation of scientifically credible information into plans? Is there

an impartial review process?

Policy and law - Are current laws and policy adequately addressed?

Cost effectiveness - Does the budget allow for the intended outcome?

Recommendation: The federal forest management agencies in collaboration with regulatory agencies and public and private interests should develop a planning process that addresses the contemporary requirements of ecosystem management, multiscales, public participation, current law, nonfederal land relationships, adaptive management, impartial review, and multiagency oversight.

As a first step, development of the watershed analysis process needs to occur. Watershed analysis is recommended in this report as an explicit element of forest planning for federal lands. A first tier of candidate basins will need to be selected. These basins will serve as prototypes where analysis procedures can be tested and refined, cost, personnel, and time estimates can be assessed, and institutional and other obstacles can be identified. Selection of these first sites should be based on the following criteria:

Physiographically representative. Because the processes and ecological issues addressed by watershed analysis will vary across the region, several initial sites should be chosen to be representative of major physiographic provinces. Identified Adaptive Management Areas (if these are included in the selected option) might be ideal sites for such efforts.

Major provinces within the owl region include:

- a. Klamath province (southern Oregon/northwestern California)
- b. Western Cascades of Washington/Oregon
- c. Coast range of Washington/Oregon
- d. Olympic mountains of Washington
- e. Eastern Cascades of Washington/Oregon.

Basin size. Basins should be between 10 to 200 square miles acres.

Multiple ownership. Addressing the institutional barriers posed by multiple ownerships will be a major challenge for watershed analysis. Basins initially selected for watershed analysis should include a mix of federal ownerships (Forest Service, Bureau of Land Management, and National Park Service) as well as watersheds falling under jurisdiction of federal regulatory agencies (U.S. Fish and Wildlife Service, National Marine Fisheries Service). Later efforts should include watersheds with a mix of both public (federal and state) and private lands.

Existing data and data-handling capabilities. To minimize startup time, watersheds selected as prototypes should have a rich store of existing data in the form of basic geographic information system layers (topography, hydrography, soils, vegetation, land-use history, etc.) as well as up and running geographic information system capabilities locally (including hardware, software, and specialist staffing for support). Data also should include time-series aerial

photographs, time series remotely sensed imagery, and stream, riparian and upland inventories (ecological unit inventories, mass movement and fire history inventories, road inventories, watershed and improvement needs inventories). Other good candidates are basins that have already been targeted for analysis through other ongoing processes or that have high quality, long-term data for other reasons (e.g., experimental forests, Research Natural Areas, former barometer watersheds, prior research involvement).

Critical issues. To provide a test of the robustness of watershed analysis for dealing with complex public interest questions, selected watersheds should represent a mix of key issues: presence of at-risk or threatened and endangered species, water quality-limited streams, presence of owl or other reserves in uplands, economically valuable timber or other resources. Initially, it may be prudent to limit the number of critical issues to one or two (if possible) to focus on the process itself, but it is expected that there will be some benefits in struggling through these first prototypes.

Local talent. The ultimate success or failure of watershed analysis (or any other process) rests with the people who will be carrying it out. While the first prototypes will likely have a high level of involvement of both regional specialists and researchers, selection should rest on sites having a good pool of trained and enthusiastic local talent (planners, resource specialists, accomplished leadership) -- people who know the ground and know how to get a job done efficiently and effectively.

Recommendation: The watershed analysis process described in this report should be tested, refined, and evaluated in terms of personnel required and costs incurred. Test sites should be selected immediately and studies implemented. The sites should be selected based upon the characteristics described in this report.

Monitoring

Monitoring is a key component of adaptive management and a needed activity for ecosystem management, implementation of conservation strategies, and compliance with forest management laws and policy. Monitoring is significant because of the uncertainty of our predictions. Though currently required, this activity, up to the present, has not been well-designed, effectively implemented, or adequately funded.

Adaptive management will be successful only to the degree that it is based upon accurate and credible monitoring. Because adaptive management is based on the ability to monitor and to make modifications, the lack of monitoring sufficiently sensitive to detect changes of ecological importance will result in the failure of adaptive management. Monitoring should occur at the relevant resource scales -- the region, the basin, the watershed, and the site (project) -- and thus be sensitive to responses of ecological systems to individual and cumulative management actions. The system should provide an acceptable basis for natural resource policy decisions.

Monitoring can be costly, so the system should be designed to serve particular policy and management needs. Additionally, monitoring should strive for collective efficiency so that data from individual projects can be integrated into a common regional data base for use beyond the original site.

A monitoring program for Pacific Northwest forests will be expensive; however, it should become a major agency activity in the future. Characteristics of an effective monitoring system include that it:

- Be objective driven, not just a list of things to measure.
- Be multiscale.
- Be scientifically designed and defensible.
- Address regional as well as local questions.
- Include independent oversight of design, quality control, and modification.

Recommendation: The federal agencies through the interagency coordination effort, should develop a multiorganizational resource monitoring system. Standards and guidelines that address design and quality control should be included. The agencies should strive to ensure monitoring activities are adequately funded and that organizational roles and responsibilities are clearly identified.

Evaluation and Adjustment

Managers often have believed they understand the full implications of current practices. They assumed implicitly that few surprises would follow -- such as endangered species listings, water quality impairments, regeneration failures, declining yields after repeated harvest, increased insect outbreaks, and increased potential for catastrophic fires. But events in the region, and elsewhere, have taught society that the full ramifications of any management strategy can never be known. Thus, managers of public lands have no choice other than to try to learn from each management decision through a process of evaluation of the results. The fastest way to learn is, philosophically, to consider all management as an experiment, remembering that much of extant knowledge comes from just such an approach.

Managing as an experiment or managing "to learn" entails implementing an array of practices, then taking a scientific approach in describing anticipated outcomes of those practices and comparing them to actual monitored outcomes. These comparisons are part of the foundation of knowledge on ecosystems on which ecosystem management might be more soundly based and in a more rapid manner than waiting for formal research results.

Managing to learn also includes society by identifying a range of treatments, and practices based upon the needs of individual communities of interest. Treatments would be distributed across the landscape, perhaps with the cooperation of adjacent landowners. This strategy allows different communities to participate and to evaluate the effectiveness of that participation. Such a strategy is included in the "adaptive management" area concept described with Option 9 (see Option Development and Description).

We must be sure "managing to learn" is not used as a license to implement a socially unacceptable agenda under the guise of "research." Thus, agencies should share decisions with the public, managers, and scientists. Scientific oversight also is required. Specific plans need to be developed that describe actions that meet species needs and are compatible with applicable laws and policies.

Managing to learn is an important extension of the concept of adaptive management. It increases societal participation and the role of science, and it diversifies management practices, so that at least some of the alternatives produce desired results, rather than putting all of the ecosystem eggs in one basket. Scientists, independent from management institutions, would help evaluate the effects of the different treatments from a scientific perspective. Experiments would be simultaneously evaluated by managers and members of society as well. Together, these groups would gain the information needed to design the next experiment and to ensure that the information gained would be shared with managers of nonexperimental landscapes. Managers, for their part, must take the evaluation process seriously because it will probably lead to changes in the way they do business -- the whole point of adaptive management.

Recommendation: Federal land management agencies should consider "managing as an experiment" or "managing to learn" an integral part of the adaptive management concept.

Research

Recent evaluations of the use, management, and conservation of Pacific Northwest forests has identified the need for advanced knowledge and understanding of forest resources. The research organizations (federal, state, and university) in the Northwest are inadequately funded to provide the science required to effectively address many of the emerging issues. Many sections of this report refer to the need for enhanced scientific knowledge. Some examples:

- Habitat requirements of many plant, animal, and fish species so that viability ratings may be improved and management programs may be designed to ensure adequate habitat while producing multiple forest values.

- Design of management strategies that will accelerate the production of "suitable" habitat.

- Design of riparian management systems and evaluations of the biological and economic benefits of fisheries restoration projects.

- Long-term ecosystem productivity impacts from forest management strategies.

- Assessment of the expectations society has for forest lands and the associated political, legal, and public relations problems.

- Economic values of ecosystem components, systems, and processes in light of contemporary planning and assessment requirements.

- Design of cost effective multivalue resource inventory and monitoring systems.

- Predictions of the future yield of forest commodities under proposed alternatives to current timber management practices.

- Addressing many resource issues at the landscape scale and larger.

Research is needed to develop analytical tools for ecosystem management. These tools include:

Risk assessment methodologies to address such issues as causes of population decline and options for protection and restoration of wild salmon stocks in the Columbia River basin.

Decision support systems and analysis methods for setting priorities, assessing risks, and defining management options at the watershed or larger scale from both a socio-economic and biophysical standpoint.

Evaluation of existing integrated monitoring of ecological condition and trends that will answer regional assessment questions.

Design of regional inventory, monitoring and evaluation data bases to support adaptive management.

Development of risk assessment and restoration strategies specific to riparian areas.

Design and testing of remote sensing systems to inventory and monitor at the landscape scale.

Research may be able to expand the resource productivity options within Pacific Northwest forests. Such options include:

Innovative forest management within riparian areas consistent with fisheries protection requirements.

Enhanced timber production on those public and private lands available and suited for this use.

Production of "nontraditional" alternative forest products, including harvesting methods, management strategies, marketing assistance, and evaluation.

Recommendation: The federal agencies in collaboration with public and private interests through the interagency coordination effort, should develop a research plan for the Pacific Northwest. The plan should:

Describe research needs specific to the strategy selected for Pacific Northwest forests.

Describe information and understanding needed to implement ecosystem management over the long term.

Tabulate and evaluate current research capabilities in the public and private sectors.

Identify research needed along three major thrusts, displaying the several levels of investment and the programs supported by each level, and including specific multiorganizational planning and management mechanisms:

1. Understanding ecosystems - Research on ecosystem processes, habitat requirements, diversity, forest health relationships, aquatic systems, fishery dynamics, and atmospheric linkages.
2. Human dimension in natural resources - Research or

determine societal resource needs and expectations, mechanism for effective participation in resource planning and management, economic analysis techniques, and information systems.

3. Alternative management strategies - Research on stand, watershed, landscape and regional management systems to produce specific or multiple resource products and values. Determine resource productivity and capability under alternative management systems. Monitoring and inventory systems and methods. Restoration systems for forest, riparian and aquatic components of the ecosystem evaluation process. Decision support systems that integrate biological, social, economic, and legal considerations.

Many of the current problems resulted because agencies did not incorporate available scientific information into plans and management activities, or they rejected scientific information for political and other reasons, real or imagined. There is little point in supporting the development of additional scientific information if it is not included in policy formulation, planning, decisionmaking, and actions.

Recommendation: Agencies should develop mechanisms to ensure that new information is incorporated into the planning and regulatory processes and the adaptive management system and that managers and staff are held accountable for incorporating this information. The Adaptive Management Area concept may be useful in furthering the development of these mechanisms.

Several large areas of forest in the Pacific Northwest have been set aside specifically for research. These include the Wind River Experimental Forest in Washington and the H.J. Andrews Experimental Forest in Oregon. Pacific Northwest universities also own and manage experimental forests. Because most of these forests are on public land, they could experience severe limitations on their use under the options in this report. For example, several large-scale field experiments designed to improve our knowledge about societal values, ecosystem processes, long-term ecosystem productivity, silvicultural alternatives, fisheries management, landscape level planning, economic evaluation, and development of habitat for threatened and endangered species have been stymied by restrictions on land use and forest management. Several research and development partnerships, addressing these issues in integrated programs, have formed within the past 2 years to address the emerging issues of the Pacific Northwest. Notable examples include the Olympic Natural Resource Center in Washington and the Cascade Center for Ecosystem Management in Oregon.

Recommendation: The Administration should explore ways to allow research to continue on National Forest or Bureau of Land Management lands where restrictions now exist or will develop from implementation of an option from this report. Research projects specifically designed to test or improve the strategy should be given special consideration.

Landscape-scale experiments are needed in the Pacific Northwest to address the many remaining biological and sociological questions. Concerns were identified as high priority, including the effects of forest fragmentation, habitat management for wide-ranging species, cumulative effects, and alternative silviculture systems within a landscape context. The social context of these concerns and the role of local communities in forest planning and management are also important. An opportunity exists for large-scale experiments to be carried out in conjunction with some of the previously mentioned recommendations, such as under the managing to learn concept, in partnerships through the adaptive management process, or in association with federal research projects noted above.

Recommendation: The federal agencies in collaboration with state and private interests should encourage the design and implementation of landscape-scale research and demonstration projects that include federal, state, and private forest land and addresses citizen roles in planning, management, and monitoring. The role of local communities in adaptive management should also be considered. These programs are to be scientifically designed to test alternative mechanisms of citizen participation and various levels of local community control of plans and activities. Adaptive Management Areas are a prime candidate for location of such efforts.

Information Resources

Although ecosystem management as a concept has a variety of definitions, a key element common to management and research is the need for consistent, accurate, and current information about basic physical and biological resources and their distribution across the landscape. Adaptive management demands that such information not only be available, but that linkages between scales of resolution be firmly established. The assembly and use of disparate data from different sources in analyzing alternative ecosystem management scenarios can be problematic.

Watershed analysis as defined in this report establishes a multiscale, hierarchical process (see Appendix VIII-A - Not included in this hypertext). To be successful, that analysis requires information collection, storage, and use, i.e., building an information base that will serve ecosystem management at multiple scales. This information base is the common link between adaptive management processes, implementation steps, and research.

Current direction to federal agencies engaged in the collection of spatial data comes from the revised Office of Management and Budget Circular A-16. It established the Federal Geographic Data Committee, which assigned lead agencies for the development of standards relating to cartographic, bathymetric, cadastral, cultural, geodetic, geologic, transportation, soils, vegetation, and wetlands information. While many of these standards are not yet far enough along to benefit this issue, they do establish responsibilities and provide a framework from which agencies are to work. This presents an opportunity for federal agencies to work cooperatively in establishing consistent information on ecosystems of the Pacific Northwest and their management.

Although cooperative efforts are largely lacking, several federal and state agencies have developed significant data bases. Most of the existing data were not collected,

analyzed, or tabulated in a consistent manner and are difficult to compare. A serious need is for standardization of data collection and maintenance.

As all forest resources become limited and their use more intensely debated, it is important that a more accurate accounting of the amount, condition, and trends become available. A multiorganizational, multivalue inventory system is indicated to facilitate effective implementation, appropriate modification, and meaningful evaluation of management and protection strategies in Pacific Northwest forests. The current fragmented inventories do not meet this need. Many resource components are not currently inventoried so populations are estimates from research studies, special surveys, and "modeled" projections. Even the more traditional commodity-based inventories such as timber volume are not standardized across ownerships and are not reliably aggregative at the various scales conducive to decisionmaking.

To implement the several interagency recommendations in this report, a multivalue inventory should be accessible to all interested parties. This could be facilitated by common protocols, database management, quality control, and a centralized delivery mechanism. Characteristics of a multiorganization, multivalue inventory system:

- Boundary neutral - should cross administrative and ownership boundaries.
- Multiscale outputs - should be useful at all scales.
- Dynamic - should include trends.
- Social, economic, biological, and physical components.
- Geographic information systems and remote sensing capability.
- Quality control standards and processes.
- Cost efficient.

The information resources assembled for this report came from many sources and covered the entire range of scale, quality, accuracy, detail, and standardization. A tremendous effort was made to assemble these data into a common format for analyses. This required several thousand worker-hours that would not have been necessary had information standards and methodologies been in place across agencies and within agency administrative designations. The databases created here are primarily contained in a geographic information system and represent the most comprehensive effort ever put forth to assemble natural resource and social information in this region.

These databases also were unique in that they were developed by an interagency geographic information systems working group assembled within the Forest Ecosystem Management Assessment Team and included data from the Forest Service, Bureau of Land Management, National Park Service, Fish and Wildlife Service, Environmental Protection Agency, Geological Survey, various agencies in Washington, Oregon, and California, and interest groups. Additional data required for this effort were digitized and entered into the database. The interagency cooperation was mutually beneficial and efficient.

A recurrent theme in all of the recommendations in this report is increased interagency cooperation in data sharing. Agencies must coordinate the collection,

maintenance, and use of key resource information. A major incentive for cooperation would be common information resources for regional analyses. These data should be derived from the same sources, and the focus of this information gathering must be at the finest scale, the project level. If coordinated, these data can be easily aggregated for use at increasingly broader scales of resolution. The databases created for this report, for example, are a beginning of an integrated set of such finer scale resource information. The following recommendations addresses both short-term and long-term issues related to the collection, maintenance, and use of key resource information.

Recommendation: Federal agencies in collaboration with state interests establish through the interagency coordination effort a central information and Geographical Information System resources database and clearing house to support the implementation effort. The agencies should capitalize on the information investment of this project (short term) and develop processes for long-term investment in information resources critical in ecosystem management. This effort should:

- Maintain and update the current database.
 - Design and test a multivalue resource inventory system for Pacific Northwest forests that is open and accessible but capable of protecting proprietary information.
 - Design a system to gather and use information on a watershed basis.
 - Coordinate resource information standards among agencies.
 - Develop and provide training.
 - Use appropriate information technologies consistent with the scales, standards, and multiagency needs.
-

Implementation Strategy

The current status of the late-successional and old-growth forests and associated forest species, and the concerns of local communities and the public, requires prompt decisions about implementation of a forest ecosystem management strategy in the Northwest. From the set of options described in this report, a preferred option may be selected by the Administration as the approach for management of the late-successional and other forests. However, no set of options could be constructed to avoid or minimize every potential ecological problem or societal concern. The solution is to establish a workable process where potential problems can be identified and resolved before they become major conflicts. This section describes that process.

The land management and regulatory agencies, through the Agency Coordination Working Group, are currently working together to develop more specific guidance based upon the following concepts and are expected to provide more explicit direction in a separate report. Therefore, this section will only describe the general concepts of an implementation strategy.

The primary goals of an implementation strategy are:

- To provide a basis for rapidly incorporating the concepts of ecosystem management into federal agency planning processes.
- To reduce potential conflicts by shifting from an ownership boundary to a watershed scale.
- To help frame a common approach among agencies.
- To identify opportunities for improving and increasing interagency cooperation.
- To identify incentives to encourage public support and participation.
- To clarify budgetary needs.

The preferred option may be implemented through administrative processes consistent with existing law, new legislation, or a combination of both processes. If administrative processes are used, implementation will require National Environmental Policy Act documentation and must be consistent with and responsible to other applicable regulatory mechanisms, such as the Endangered Species Act, Clean Water Act, etc. These planning and regulatory processes should be closely coordinated to avoid delays in implementation.

Current planning and regulatory processes provide the basis for implementing a conservation strategy, but ecosystem planning on federal lands will drastically change the way that agencies conduct business. It will require an unprecedented level of interagency cooperation, involving the coordinated efforts of all federal agencies involved in planning and regulating of forest and forest-related activities in the Pacific Northwest and northern California. Effective implementation of an ecosystem management approach requires that other parties (e.g., landowners, stakeholders, etc.), not just federal agencies, be integrally involved.

Planning Levels

Implementation of the selected option will rely on general recommendations (standards and guidelines) that will need to be refined at increasingly more site-specific levels, as we move from the regional, to province, to watershed, and finally to the site (or project) level. In moving to the long-term goal of true ecosystem management, we will need to refine and revise components at each of the following steps:

- A regionwide conservation strategy that provides general guidance to be considered at lower planning levels.
- A physiographic province conservation strategy that provides more specific guidance for land managers to consider as they develop site-specific planning strategies for watersheds or other units of analysis and planning.
- A watershed level analysis for individual watersheds that takes into consideration site-

specific information and needs, and which provides the basis for refinement of provincial conservation strategies as well as project-level decisions.

A regionwide plan provides a method for standardizing processes across provinces. However, the physiographic province is intended to become the focal point for ecosystem planning. Conservation plans, developed at that level, are ultimately expected to replace the current forest (National Forest) and district (Bureau of Land Management) plans (see Figure). These provincial plans should be explicit enough to assess impacts of actions but still be advisory in nature to allow flexibility at the local level because two agencies, the Forest Service and Bureau of Land Management, will still have basic decisionmaking responsibility on those lands.

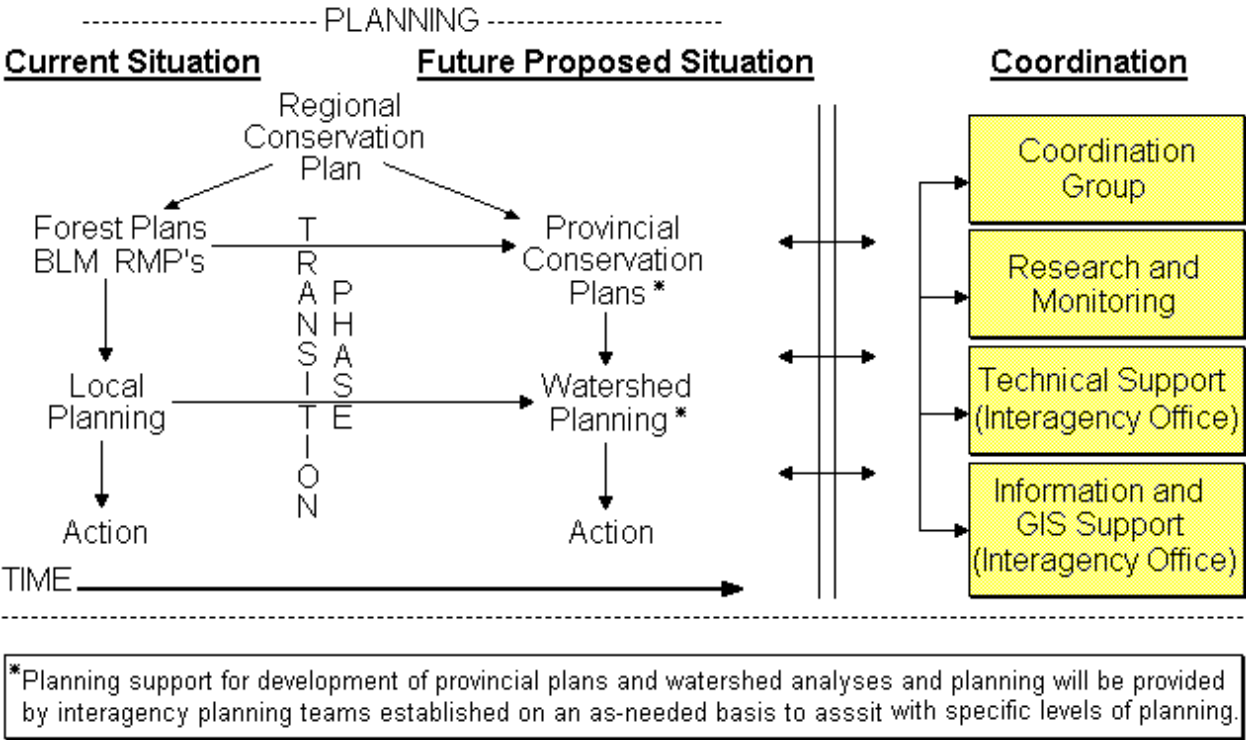


Figure 8-6. Relationship between current and proposed planning, and interagency coordination efforts.

Watershed analysis is proposed as a key component of the general framework for identifying and assessing appropriate actions at the local level (see Ecosystem Management). Watershed analysis would be the foundation for revising province-level plans as information is collected and assessed through the adaptive management process, and would provide a method to assess the current situation and relationships between species and mechanisms that should be considered as a whole. Land planners will need to assess the appropriate analyses. Our discussion uses this approach in identifying the major steps in implementation.

The transition from forest-based or district-based land management planning to planning at the provincial/watershed scale may be difficult for agency planners. Time frames and schedules appropriate to individual agencies will affect the development and completion of planning in the short term but will become less constrictive as we adapt planning to focus on the long term through the steps identified here (see a tentative stepdown schedule in this Table). Interagency planning teams may be needed to make a smooth transition from the current to the proposed planning scenario (see Interagency Coordination and

Figure).

The intent during this period is three-fold: (1) refine the option and standards and guidelines so that local differences and needs can be addressed, (2) initiate adaptive management so approaches can be developed and integrated into a more ecosystem-oriented approach to land-use planning, and (3) identify and resolve potential regulatory conflicts (e.g., endangered species concerns) early in the planning process so delays can be avoided or mitigated.

Table 8-2.

The Process of Adjusting and Adapting the Selected Option Through Time

Short Term	Estimated Time	Planning and Regulatory Processes	Reserve Boundaries	Reserve S&G's	Matrix S&G's	Existing Plan Allocations
Regional EIS	2-6 months	NEPA (EIS) (Section 7)	Establish, subject to future refinement	Establish, subject to future refinement	Establish, subject to future refinement	To be determined
Interagency review for physiographic provinces or other ecological zones	1-6 months	None	Refine terrestrial boundaries, refine guidance	Refine based on province/zone information	Refine and adopt based on local information and subject to existing plan allocations	Change only as necessary to adopt reserve boundaries and new S&G's provide interim PSQ figures
Forest and District plan revisions	3-9 months	NEPA (EIS) (Section 7)	Refine and adopt terrestrial boundaries and interim aquatic boundaries	Refine and adopt based on local information	Refine and adopt based on local information and subject to existing plan allocations	Change only as necessary to adopt reserve boundaries and new S&G's provide interim PSQ figures
Watershed and project analysis	6 months to 3 years	None (EA)	Refine terrestrial and aquatic areas based on local information and analysis	Refine based on local information	Refine based on local information and apply within context of existing plan allocations	Use existing allocations but analyze opportunities for new allocations
Province-level conservation strategies/plans	2-4 years	NEPA (EIS/EA) (Section 7)	minor refinement and adoption of all boundaries	Adopt - refine if needed	Adopt within context of new allocations	Reconsider all existing allocations based on information from watershed analysis. Provide new PSQ figures
Continuing Adaptive Management	Ongoing	(As Necessary)	Continue refinements based on the adaptive management questions and processes developed in this effort	Continue refinements based on the adaptive management questions and processes developed in this effort	Continue refinements based on the adaptive management questions and processes developed in this effort	Continue refinements based on the adaptive management questions and processes developed in this effort

This is a chart of how various portions of the conservation strategy could be adopted and refined through time through a series of agency actions. Interagency oversight is needed for each of these steps, but there is opportunity for significant local input and control. Change in PSQ would occur due to reconsideration of existing plan allocations and to refinement of Riparian Reserve boundaries following watershed

assessment. The Forest and District plan revisions including changes in existing allocations and in reserve boundaries, would all be driven by information collected as part of the watershed analysis process.

Implementation Strategy Components

There are similar components in all the options that will need to be considered in implementation. The five specific components to consider are:

1. Late-Successional Reserves and Riparian Reserves with specific boundaries delineating the areas.
2. Standards and guidelines for managing the reserves.
3. Standards and guidelines for managing the forest Matrix (between reserves, including the Adaptive Management Areas) and Key Watersheds.
4. Analysis procedures.
5. Monitoring protocols.

Refinement of these components will occur through a series of steps in agency planning. Through these steps information will be integrated and aggregated at different planning levels and adjustments made in the regional as well as more locally based plans, as appropriate.

There may be some initial concern over the need for additional levels of planning (and planning teams), but the described process should help reduce that perception as the transition unfolds. The entire process, described here, is intended to provide for a smooth transition, so that there is consistency in planning as an option is selected, implemented, and refined over time. This will require an interim phase during which time the current plans will need to be revised and actions taken to meet specific time frames (see Actions in the Transition Phase). Short-term actions may be different than those proposed for the long term, although they should be consistent and be focused on obtaining overall objectives.

Because changes in agency planning may evolve as the concepts described in this document are tested, it is premature to describe in any great detail a step-by-step approach for long-term planning. The specific approach will depend upon the focus of the planning unit (e.g., forest or district, province, watershed), and will require close cooperation and oversight to ensure consistency with long-term goals. This process will require an extensive training and education program for professional staff, and should include members of nonfederal entities and the public.

Phase of Implementation

Implementation should occur in several phases. Although use of the word "phase" indicates sequential steps, we recommend that some of the actions identified here be implemented immediately and concurrently to the extent possible to reduce the time involved in making the transition from current operations to a focus on the watershed and provincial levels. Management activities will continue in keeping with the selected option and current plans until new plans are completed.

Phase I: Develop options to satisfy the objectives outlined in the instructions to the Team (see Preface - Not included in this hypertext). This was partially achieved by this overall report. This Phase is complete when an option is chosen.

Phase II: Identify and carry out actions that need to be completed in the immediate future (e.g., within the first year).

1. Refine regionwide components (reserve boundaries, standards and guidelines).
2. Complete regulatory requirements and initiate project planning (as appropriate).
3. Complete development of the watershed analysis approach incorporating concepts for assessing both riparian and terrestrial species.
4. Design and implement adaptive management process, including establishment of coordination efforts, monitoring and research programs, and a multiagency information system.
5. Identify priority activities necessary for the next phase (e.g., prioritize watersheds for analysis, identify test areas, continue assessment of species of concern).
6. Initiate training, education, and public information programs.
7. Facilitate a short-term timber sale program.

Phase III: Identify and carry out actions that need to be completed in the short term (e.g., 1-4 years).

1. Refine the components described in the regionwide strategy at the province level (e.g., boundaries and standards and guidelines applicable to each of the physiographic provinces) and begin development of provincial conservation plans.
2. Carry out agency planning processes to develop or revise Forest Service forest plans and Bureau of Land Management district plans.
3. Complete regulatory requirements between land management and regulatory agencies.
4. Refine the watershed analysis process and initiate high priority watershed analysis.
5. Identify high priority actions required for the next phase in the planning process (refer to recommendations in this chapter).
6. Facilitate achievement of the timber sale level specified in the selected option.

Phase IV: Identify and carry out actions that need to be completed to implement a selected (and refined) option over the planning period (e.g., 1-10 years).

1. Continue watershed analyses.
2. Refine the provincial guidelines at the watershed level for each watershed identified within the planning process
3. Refine forest/district or provincial level plans as necessary to meet the goals and objectives resulting from the watershed planning process.
4. Complete regulatory requirements (as needed).
5. Facilitate achievement of the timber sale level specified in the selected option.

Recommendations: The federal resource agencies should immediately initiate steps so that implementation of the selected option can proceed smoothly. These steps include:

Establish a coordination group with appropriate work groups and supporting office(s), including assessment of nonfederal involvement.

Establish local planning teams to develop agency plans.

Initiate and conduct a comprehensive monitoring and research program and develop a method for maintaining, standardizing, and updating analysis tools and interagency databases, from the "ground up," with particular emphasis on a Geographical Information System.

Develop the framework for carrying out watershed analyses, including the steps that identify how to apply the watershed analysis concept to upland and other terrestrial species, and the priority areas where watershed analyses would be initiated.

Develop the framework for integrating the adaptive management concept into agency planning and decisionmaking processes.

Determine budget, staff, and organizational/structural changes needed to adapt existing planning processes and methods of doing business.

Initiate training and education programs.

Facilitate the achievement of the timber sale levels judged appropriate in the selected option.

Actions in the Transition Phase

An orderly transition is needed as we move toward implementation of a preferred option for future forest management. A major issue is continuation of ongoing programs (e.g., timber sale programs) and, specifically, decisions on existing timber sales that were planned under previous agency management plans.

An evaluation of these sales has been initiated by the Forest Service and Bureau of Land Management. Over 1,300 timber sales currently exist, including sales developed under Section 318 of Public Law 101-121, sales that are currently enjoined, and new sales that have been planned. Most sales have already passed through the regulatory and planning requirements of applicable laws and policies. Steps should be taken to provide for completion of the review for remaining planned sales.

Evaluation of these sales will require careful consideration of the effects they may have on the ability of the options to meet the specified objectives. Priority for timber harvest should be given to existing sales that have the least impact on the described options.

Sales outside of areas, such as Key Watersheds, roadless areas, marbled murrelet habitat, spotted owl reserves, and critical habitat, should be given priority for consideration in any interim timber sale program (See Aquatic Ecosystem Assessment for examples of factors to be considered when structuring sold and awarded, enjoined and prepared (unenjoined) sales). The agencies should continue to cooperate in developing guidelines, using the information in this document, to help identify sales that can be harvested in the immediate future.

Recommendation: The land managing and regulatory agencies should coordinate their reviews of existing sales so that a timely decision can be made and sales carried forth immediately in keeping with the selected option.

Planning and Regulatory Mechanisms

The Assessment Team was requested to provide a set of management options that complied with all requirements of applicable law, including the Endangered Species Act. For listed species within the range of the northern spotted owl, the federal land management agencies are responsible to carry out programs for the conservation of listed species and to insure that any action funded, authorized or otherwise carried out by the federal agency is not likely to jeopardize the species' continued existence or result in the destruction or adverse modification of critical habitat. A proactive (but not mandatory) responsibility of federal agencies is to take actions that contribute to the recovery of listed species through the recovery planning process.

One aspect of the Assessment Team's analysis rates the sufficiency, quality, distribution and abundance of habitat to allow the species populations to stabilize across federal lands. This viability of federal habitat does not directly correspond to viability of the affected species. This is due, in part, to impacts or

cumulative effects from nonfederal activities and to activities in other habitat sectors where the species might spend a portion of their life cycles.

As a result, it may not be possible to construct an option for forest management that obviates the need for continued regulatory review of the impacts of actions that may affect listed species, water quality, or other laws. The federal land management agencies intend to consult under Section 7 with the Fish and Wildlife Service on implementation of the preferred alternative that is selected from this report. Because of the lack of sufficient detail, this consultation will likely not be sufficient for implementing specific actions, such as provincial conservation strategies or individual actions (e.g., timber sales) without additional consultation on these actions in the future.

Therefore, it is critical that the land-managing and regulatory agencies work closely together through the implementation process associated with the chosen plan to ensure that conflicts can be identified and resolved early in the planning process so that future train wrecks are avoided. This will require that the agencies find new ways and methods of communicating such that integration of their activities becomes a normal and accepted method of future operations.

In the long term, the planning and regulatory processes should be better coordinated and should take a proactive approach to problem solving so that consistency in conservation strategies can be obtained. Appropriate regulatory processes (e.g., through Section 7 of the Endangered Species Act or Environmental Protection Agency water quality programs) will need to be integrated with the applicable planning processes at an early stage in planning to avoid delays or future conflicts.

Regulatory agencies should become involved at the field level in planning from the initial stages. This will result in a shift in regulatory review from later in the planning process to an earlier phase -- a significant change in the way of doing business. The intent of early review is to help identify potential regulatory conflicts (e.g., actions that may impact listed or candidate species) so that actions can be taken to avoid or reduce those conflicts before irretrievable commitments of resources have been made.

The primary planning and regulatory processes are based on provisions of the National Environmental Policy Act, National Forest Management Act, and Federal Land Policy and Management Act, Endangered Species Act, and Clean Water Act. Agencies must also comply with a variety of other laws, such as the Migratory Bird Treaty Act, Coastal Zone Management Act, Clean Air Act, and the Administrative Procedures Act. The objectives of some of these laws as well as their substantive and procedural requirements are not uniform. Moreover, their interpretation falls to different agencies. To facilitate implementation of the selected option, the federal agencies should work together to develop a common understanding on the interpretation and application of the appropriate statutes in relation to the responsibilities of the individual agencies so that problems or delays can be minimized.

Recommendation: The planning and regulatory agencies should establish ad hoc planning teams to assist in initiating cooperative planning efforts at the provincial and local level (watershed) so that land use decisions can be made with the greatest level of input early in the decisionmaking process. Agencies should evaluate both short and long term staffing needs to ensure they can accommodate this level of involvement in planning so that budgetary needs can be anticipated.

Interagency Coordination

The achievement of ecosystem management goals seems likely to require a greater level of coordination and cooperation than has existed. This may be even more true in areas of mixed federal and nonfederal ownership. Coordination among the land-managing agencies and between the land-managing and regulatory agencies is critical to successful implementation of any option (see Implementation Oversight).

Improved coordination might profitably involve establishment of a regional coordinating group, which includes representatives of the primary participants in land management planning. To be successful,

particularly in the short term, any coordination effort would involve permanent technical support groups to carry out day-to-day activities and might include staff from all appropriate federal agencies (Figure). These groups should be responsible for such tasks as ensuring adequate participation and timeliness in planning, monitoring, guiding, analyzing new information, and providing a forum for deliberating questions.

Technical teams under the coordination effort would be responsible for the following activities:

- Review and refine options (from the regionwide to the local level, including refinement of boundaries and standards and guidelines).
- Provide information and education to appropriate parties.
- Provide agency guidance on key issues.
- Help respond to problems and concerns, including biological, social, and legal.
- Prepare for future adjustments to plans and activities.
- Coordinate monitoring activities, data information management, and sharing of information.

Local planning teams also will be necessary to assist in coordinating the appropriate planning and regulatory processes at the local level (e.g., province and watershed) and help respond to problems and concerns. Planning and analysis teams would be expected to operate at the field level and would include staff from cooperating agencies to the extent that they would need to help assist in planning. Regulatory agencies could profitably participate on these teams primarily to provide guidance. These ad hoc teams are not intended to be a subset of the overall regional coordination group, except to the extent that guidance would be needed from that group. They are primarily intended to provide technical support to agencies as those agencies carry out planning. This Figure illustrates the relationship between ad hoc agency planning teams and the more formal interagency coordination effort.

Interagency planning teams would work primarily through the land-managing agencies in cooperation with other appropriate agencies (National Marine Fisheries Service, Fish and Wildlife Service, Bureau of Indian Affairs, Environmental Protection Agency), states, and tribes. These ad hoc teams should become part of an agency's regular planning efforts at the field level. This level of planning may affect current staffing levels and assignments.

Because of the importance between land ownerships in an ecosystem approach to forest management, it is critical that federal/nonfederal partnerships be retained and fostered. Both regional and local efforts should include close coordination with the appropriate state agencies, tribes, interest groups, and local communities.

It also would be appropriate to include representatives of these groups at various levels in the planning process especially where management actions on federal lands may affect or be affected by actions on nonfederal and tribal lands (see Relationship to Nonfederal Lands). This would allow nonfederal parties to participate in the planning process as opposed to reacting to the results of those processes after decisions are made. Regional planning councils, for example, may provide an appropriate forum. This may be most appropriate in application of the "adaptive management" area concept described under Option 9 (see Option Development and Description). It should be noted, however, that the land management agencies have the sole responsibility for the decisions that are finally made.

The number and types of groups involved in coordination will depend on the type of planning being undertaken. Phase I would mainly involve the primary federal agencies (both field and higher level groups). Later phases would likely include active participation of state and local groups to ensure that state

and local interests and responsibilities are identified and addressed, especially at the provincial level of planning. The degree to which these groups would be involved should be decided as the more formal groups or teams are established after selection of a preferred option.

To assist in the immediate transition from development of a set of options through refinement and implementation of an option over the next year may require establishment of a temporary interagency working group. This temporary group would continue analysis of the issues raised through the initial planning process, help expand the selected option into a more detailed plan, address questions raised by the planning and regulatory agencies as they move toward implementation, and assist in developing concepts of watershed and adaptive management processes.

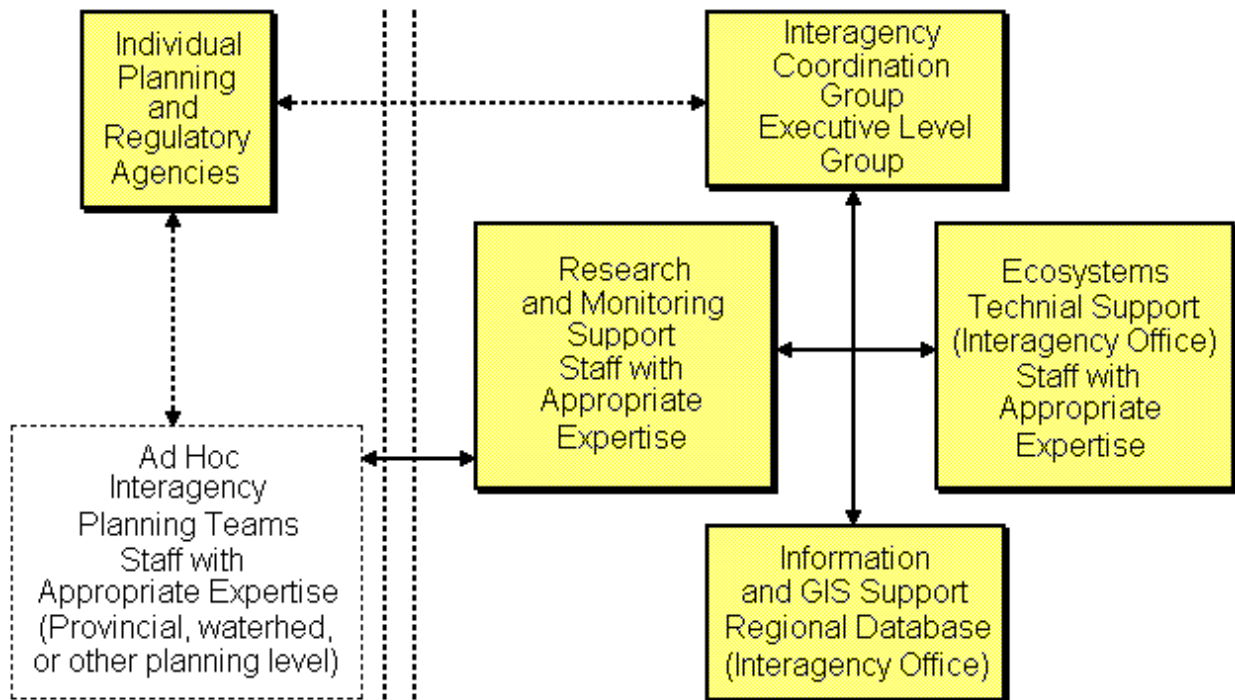


Figure 8-7. Relationship between agency planning processes and interagency coordination efforts.

Recommendation: Agencies should establish an interagency working group to assist in the transition from completion of a set of options until agencies have completed their planning processes or a more formal coordinating group has been established that has assumed responsibility for this process.

Implementation Oversight

Because of the history of distrust and concern generated from past activities, there is a strong need to ensure that planning, monitoring, and implementation can be accounted for at least in the short term. Oversight is essential to ensure that adequate and timely steps are being taken to meet the goals of this process.

Recommendation: Draft plans should be submitted for independent technical review. The process for attaining such review should assure selection of appropriate credentialed reviewers.

Recommendation: The agencies and interagency coordination group should be responsible for reporting annually to the Administration on the status of implementation, on problems encountered, and on progress made relative to the selected option.

Relationship to Nonfederal Lands

The majority of species inhabiting late-successional forests in the Pacific Northwest are not restricted to habitat on federal lands. Maintenance of viable populations on federal lands will depend in part on how actions on nonfederal lands in the region affect the status of those species. Whatever their relative location and proximity to federal lands, nonfederal lands are an integral part of any strategy that seeks to address the overall landscape as an ecosystem. This is particularly important for threatened and endangered species or other at risk species.

Both federal and nonfederal lands contribute to maintenance of healthy ecosystems in a variety of ways including contributing to management of riparian or upland areas for habitat, contributing to soil and site productivity, managing a range of forest age classes for timber production, and developing information useful to future ecosystem management planning efforts. Therefore, if this interrelationship is to be considered in an ecosystem management approach, it will require cooperation between state agencies, tribes, private landowners, and federal agencies. Overall benefits to society that may accrue from ecosystem management will be optimized only if the relationships among federal and nonfederal lands are examined and collaboration encouraged during planning and implementation for the federal lands. This will be successful only to the extent that nonfederal landholders choose to participate..

Coordination of activities will play an integral part of ecosystem management at the regional, provincial, and watershed scales, regardless of the landowner or manager if ecosystem management is to achieve its anticipated potential. Because of the importance of using a watershed scale for successful ecosystem management, planning activities for mixed ownership areas should be coordinated with nonfederal agencies or landowners wherever appropriate and wherever nonfederal landholders choose to be involved. Watershed analyses and implementation of watershed management activities on nonfederal lands should be carried out through a multiagency (state and federal) process that facilitates participation of all parties with a stake in the process.

The states should be actively involved by taking the lead in developing conservation ecosystem management objectives applicable to nonfederal lands. This can be accomplished through state-led working groups with federal agency participation.

Planning for ecosystem management can identify opportunities to provide incentives to nonfederal landowners and managers. Mechanisms for providing incentives should be explored to encourage cooperative and coordinated efforts. These might include trading land to protect critical areas or reducing protection on some areas of federal lands in return for contributions to habitat protection and ecosystem management on nonfederal lands ensured by appropriate legally binding agreements, such as easements. Additional assistance may be made available in the form of expertise, coordinated spatial analyses with Geographical Information System and access to information systems, cooperative monitoring and analyses, and support through existing grant and assistance programs. Projects such as the Applegate/Ashland Watershed Project in Oregon illustrate integrated efforts where federal and nonfederal parties can work jointly on developing planning efforts on a landscape basis.

Aspects of some federal laws are relevant to implementation of ecosystem management for both federal and nonfederal landowners and managers (e.g., the Endangered Species Act, Environmental Protection Agency programs). This is important for those species currently listed under the Endangered Species Act. Even as provisions are implemented on federal lands to maintain viable populations of these species (e.g., spotted owl, marbled murrelet, salmon), there will remain a need to provide protection to those species and habitats found on other land ownerships.

A proactive approach to reduce potential conflicts such as preventing future listings should be emphasized here. The information gathered through watershed and other cooperative analyses can be used through conservation planning processes under the Endangered Species Act to help nonfederal landholders contribute to preventing listing of candidate species at their discretion. Planning tools, such as conservation agreements, also offer ways to reduce the need for future listing of species and, thus, avoid conflicts with the Endangered Species Act. In these types of planning processes, priority should be given to finding ways of handling problems with multiple species (e.g., the spotted owl, anadromous fish, marbled murrelet), so that there is not an additive effect. While the needs of different species will need to be addressed, to the extent possible planning should take the opportunity to focus on ecosystems and not on specific species (e.g., the spotted owl).

A number of programs and authorities may be useful in the coordination of activities on federal and nonfederal lands. State agencies implement a wide range of programs for protection of water quality and aquatic life, including the Clean Water Act Section 319, and the Coastal Zone Act Reauthorization Amendments Coastal nonpoint source programs. Environmental Protection Agency statutes address nonpoint pollution control on nonfederal lands and provide funding through grants for implementing program requirements.

The Environmental Protection Agency also has initiated a watershed protection approach that recognizes the need to refocus water quality programs on geographically targeted areas. The target watersheds are those where pollution or ecological stressors pose the greatest risk to human health, ecological resources, or desirable uses of water. This approach encourages and facilitates the participation of all parties with a stake in the local situation in the analysis of problems and the development of solutions. The watershed approach provides for the participation of different levels of government, multiple agencies, and groups. These cooperative projects are intended to integrate the applicable authorities and techniques into a multi-organizational action to address the ecosystem problem. These projects also provide opportunities for using land management practices which take into consideration ecosystem concepts and contribute to the overall goal of ecosystem management. Partnerships between local, state, and federal parties offer unique opportunities to share information on these practices and to test different management techniques (e.g., Applegate Project).

Recommendation: Nonfederal entities, including states, private interests, and tribes, should be encouraged to participate in an integrated approach to ecosystem management for nonfederal lands. This approach should draw on the appropriate state agencies, private interests, and tribes to develop and implement an ecosystem management strategy and should be carried out in close cooperation with federal interagency efforts and private interests. Appropriate mechanisms for federal agency involvement should be determined. These mechanisms and roles will need to be established by the recommended interagency coordinating group.

Recommendation: Federal agencies should work with the states to coordinate the planning and implementation of the selected option for federal lands, with a strategy for nonfederal lands. This coordination should occur from the earliest stages of planning and analysis and should encourage private involvement and commitment. Appropriate mechanisms for this coordination should be developed by a coordinating group (which includes nonfederal representatives) for the regional, province, and watershed scales. A mechanism should also be developed to facilitate technical assistance and transfer of research results and lessons learned from the adaptive management process to managers of nonfederal lands.

Administrative, Budget, and Staffing Needs

Because this interagency approach requires up front involvement by all the agencies, past methods of operation must change to accommodate a more interactive approach to planning along with opportunities for others (e.g., states, interest groups) to participate. Greater benefits to society will result from this type

of approach, particularly from the standpoint of avoiding or reducing the conflicts that currently arise from the lack of coordination between agencies. However, barriers exist in changing the way that agencies carry out planning, such as changes in current approaches to planning, in budget and staff allocations, in organizational structure, and in the methods to evaluate performance and accountability.

The greatest impact on the implementation of any plan is the availability of adequate resources (staff and budget) to carry out the expected tasks. The current budget process may not be compatible with integrated resource management, particularly one such as is proposed here. The magnitude of the changes will require a change in the way Congress allocates budgets, particularly for the land-managing agencies who previously received funds based on an assessment of commodity and other resource-based output. Considerations, such as funding to support habitat restoration projects and, in particular, funding to support a strong monitoring program, will be essential. Monitoring may be the most important function to be undertaken throughout the life of the plans (see Adaptive Management).

Regulatory and land management agencies need to change the focus of their mutual involvement from an adversarial to a more cooperative situation. This will entail a change in the way mandates are carried out and a shift from pure regulatory review to a more planning-oriented process.

Recommendation: Congress should be encouraged to revise the appropriations process to better provide for the land management agencies' ecosystem-based objectives and activities, rather than link appropriations primarily to commodity outputs.

Recommendation: Land management agencies need to determine the potential commodity output levels based on land capability, compliance with applicable laws, and ecosystem sustainability.

The Forest Ecosystem Management Assessment Team did not examine the potential costs to the federal government of implementation of the options described in this report. However, the team is concerned about some public assumptions. Considerable effort will be needed to carry out the expected planning, monitoring, research, and associated projects that are essential to the success of this effort. This includes a recognition that the roles and needs for current staff do not disappear, but evolve as we implement new ways of conducting business. Sufficient funding needs to be available to support the efforts described in this document.

Pending additional fiscal analysis, **we emphasize that the option selected should not be hastily coupled with reductions in funding and personnel based upon the inappropriate assumption that ecosystem management is somehow cheaper than traditional commodity production-focused plans.**

Recommendation: The Secretaries of Agriculture, Commerce, and Interior, and the Administrator of the Environmental Protection Agency should consider a review of the steps necessary to undertake a more coordinated and cooperative interagency approach to planning.

Conclusions

We have presented our view of steps to be instituted to achieve the ecosystem management approach that may be adopted as the policy of the Forest Service and Bureau of Land Management. Obviously, there are other potential means of carrying out the next phase(s) of the conversion to ecosystem management that build on the framework laid out in this report. However that is accomplished, it is well to note that the selection of any option in this report is only the first building block for ecosystem management. It is visualized that a second phase be initiated whereby the concept is extended to a broader land base and in a larger landscape context.

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Appendix VIII-A

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Appendix VIII-A

Methodology of the Forest Ecosystem Management Team with Respect to Information Development

Considerable effort brought the best information, technology and people together to support the analytical needs of the Forest Ecosystem Management Assessment Team. The following describes the effort to build a spatially explicit database and utilize geographic information system technology. It does not include a full discussion of the data and analysis needed to analyze current timber volumes nor projections of allowable sale quantity. For a full discussion of this analysis see the "Economic Assessment chapter. This is provided as a context with which to evaluate future needs and as a record for future reference. A significant effort was made to document all of the data used and processes employed during this project. If information is not contained here, it can likely be found in the project records.

Information

Much of the spatial information used in this effort was coordinated through the Geographic Information Systems Analysis Group. This group within the Forest Ecosystem Management Assessment Team was an interagency group whose charge was to locate and assemble the required information and provide analyses in support of the scientists and others on the team. The group created a spatially unified database for the study area -- the range of the northern spotted owl, approximately 57 million acres. Most of the data came from the USDA Forest Service, USD1 Bureau of Land Management or the USD1 Fish and Wildlife Service. Data was also received from the U.S. Environmental Protection Agency, U.S. Census Bureau and the USD1 Geologic Survey. Sources outside the federal government include all three states (Washington, Oregon and California), the EROS Data Center (Earth Resources Observation Satellite), the Natural Heritage Database, Oregon State University, and others.

Technology

We used state-of-the-art hardware and software technology extensively for this effort. This included six IBM RS6000 workstations and six SUN SparcStations utilizing the Arc/Info (Environmental Systems Research Institute, Inc.), ERDAS Image Processing (ERDAS, Inc.), and Oracle Relational Data Base Management System (Oracle Corp.) software. Both the Bureau of Land Management and Forest Service provided plotting services on color electrostatic plotters. Digitizing and scanning were accomplished on microcomputer-based Line Trace Plus systems. [Note: mention of trade names of software and hardware is intended as information only, it is not a endorsement or recommendation by the Forest Ecosystem Management Assessment Team nor any of the affiliated agencies.] Given the time allowed, there was little choice but to assemble fast equipment, reliable software, existing digital data, and the most experienced people who could be found. Much of this was already available within the three agencies. Normally, a project of this size and scope would require many times the 2 months allowed, and this did have negative, though not critical, impacts on the analyses and options presented here. We expect that additional analyses will build on this process in the future. The development and maintenance of spatial data requires an investment of time and information resources and a commitment from managers to collect and maintain data that meet agreed-upon standards.

Capabilities of the technology, data, and people were available to produce nearly any needed analysis or produce virtually any type of output desired. Even so, prioritization was required because there simply was not enough time to complete all of the desired analyses. Additionally, time constraints did not permit any major digitizing efforts to capture new information across the study area. Hundreds of hard copy maps utilizing available digital data maintained by the agencies were produced over the span of the project area showing everything from distribution of species to maps portraying what the forests of the Pacific Northwest might look like 50-150 years from now under different management scenarios. Visual displays are powerful and represent part of the reason that geographic information system technology and spatially explicit resource information is so critical to sound resource management, particularly management based on ecosystem management principals.

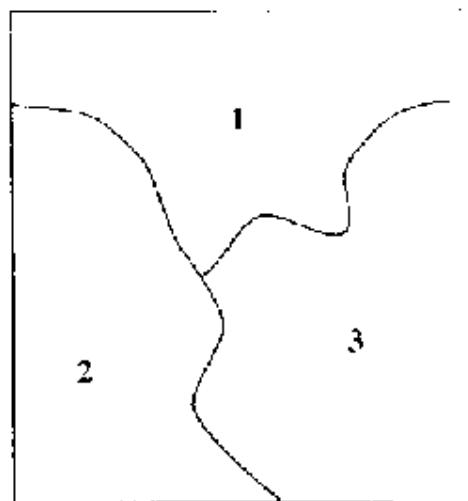
The other, perhaps more important, capability that geographic information system technology lends to such efforts involves analyzing the distribution and spatial characteristics of resources and their relationship to other phenomena. Cross tabulations of resources relative to each other were developed (e.g., acres of suitable owl habitat by physiographic province and administrative unit) for virtually all information available across the study area. Additional analyses included the computation of shape metrics (e.g., nearest neighbor, fragmentation) for vegetation. Reserve options across the landscape and over time were valuable in estimating the relative capability of the options to provide for the viability of spotted owls and dozens of other species. Information on nearly 200 species associated with late successional and old-growth forests were assembled and analyzed.

Methods

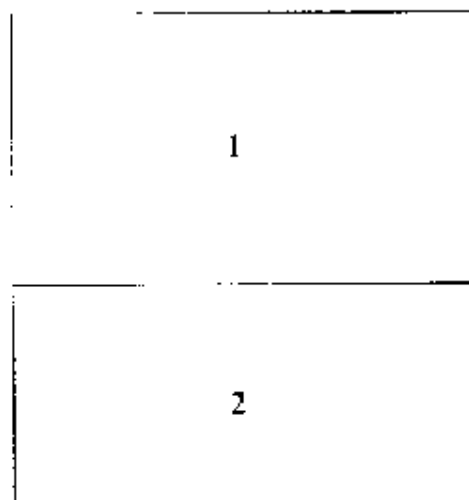
The basic methodology involved assembling the various data into a common format within the Arc/Info environment. A total of 75 map layers were captured or collected from various sources. Another 115 species range maps were also collected and treated as a single map representing the species analyzed by the Scientific Assessment Team. Once installed and accuracy checked, 31 of these map layers were converted to a raster based data structure (see fig. A-i) with each cell in the data structure representing a land area 400 meters square (approximately 40 acres or 18 hectares) within the Arc Grid software environment.

The advantage a raster-based data structure provides relates primarily to the speed with which analyses can be completed and the fact that many analytical processes are more easily performed in a raster environment. Vector-based operations are computation intensive and require significant input/output communications resources. Raster-based data structures use a simple row/column Matrix that streamlines computational transactions and reduces communications bottlenecks. It is fundamentally easier for a computer to perform raster-based transactions than it is to calculate the new geometry of combined vector-based data during analysis operations. Another reason for moving to a generalized grid was **it** was an easier environment for combining disparate data

First Map (vector)



Second Map (vector)



		Attribute					
Poly B	1						
Poly A	2						

Attribute Table
First Map

First Map (raster)

1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1
2	2	1	1	1	1	1	1	1	3	3
2	2	2	1	1	1	1	1	3	3	3
2	2	2	2	1	1	1	1	3	3	3
2	2	2	2	1	3	3	3	3	3	3
2	2	2	2	2	3	3	3	3	3	3
2	2	2	2	2	3	3	3	3	3	3
2	2	2	2	2	3	3	3	3	3	3
2	2	2	2	2	3	3	3	3	3	3
2	2	2	2	2	3	3	3	3	3	3
2	2	2	2	2	3	3	3	3	3	3

Second Map (raster)

1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2	2	2
2	2	2	2	2	2	2	2	2	2	2
2	2	2	2	2	2	2	2	2	2	2
2	2	2	2	2	2	2	2	2	2	2
2	2	2	2	2	2	2	2	2	2	2

	Row	Column	Attribute				
Cell 1	3	2	2				
Cell 2	1	1	1				

Attribute Table
First Map

New Map (raster)

1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1
3	3	1	1	1	1	1	1	5	5	5
3	3	3	1	1	1	1	1	5	5	5
3	3	3	3	1	1	1	1	5	5	5
3	3	3	3	1	5	5	5	5	5	5

	Row	Column	New Map Attribute	Attribute Map 1	Attribute Map 2		
Cell 1	3	2	3	2	1		
Cell 2	1	1	1	1	1		

1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1
3	3	1	1	1	1	1	1	1	5	5
3	3	3	1	1	1	1	1	5	5	5
3	3	3	3	1	1	1	1	5	5	5
3	3	3	3	1	5	5	5	5	5	5
3	3	3	3	3	5	5	5	5	3	5
4	4	4	4	4	6	6	6	6	6	6
4	4	4	4	4	6	6	6	6	6	6
4	4	4	4	6	6	6	6	6	6	6
4	2	4	4	4	6	6	6	6	6	6
4	4	4	4	4	4	6	6	6	6	6

	Row	Col	New	Att	Att					
Cell 1	3	2	3	2	1					
Cell 2	1	1	1	1	1					

Attribute Table
New Map

Figure VIII-A-1. Schematic diagram illustrating vector-based maps, associated attributes and the process of combining raster maps.

Database Reporting

Once the core data were converted to a raster-based data structure with associated attribute data, all of the raster data sets were combined into a single raster (see fig. A-i). Essentially, a single raster was developed with all of the associated attribute data related to all of the 31 mapped data associated to a single raster. Because the attribute data, at this point, all resided in a single table of information, this table was exported and used in a Relational Database Management Software (RDBMS) environment. Moving the attribute data to this environment allowed fast and efficient reporting of resources and relationships between resources. This methodology allowed both simple and complex database queries to be performed. One disadvantage of this methodology was that any updates of the core data required several steps to effect changes to the database before update queries could be performed. Once assembled, the database provided the ability to quickly produce statistics by option, province, state, administrative unit or any other component contained in the database.

An important aspect of this approach was the ability to quickly and accurately visualize the results of specific queries. Because of the nature of a raster data structure, output involves the reporting of cells in the raster that meet the criteria defined in the query and can include the exact location in the raster of each cell meeting these criteria. If the results of a specific query include the row and column location of each cell meeting these criteria, it is simple to route this information back to the geographic information system software and display the result regardless of the database tool used to perform the query. This process allowed both a tabular summary and visual display of information so fundamental in using geographic information system technology.

The reports and hard copy maps generated were subjected to rigorous accuracy checking that compared output to source information. Discrepancies were identified and routed back for additional comparisons to either database analysts or geographic information system analysts for error determination and

correction. It is important to acknowledge that the accuracy of information produced is only as accurate as the least accurate part. While some of the information used in the analyses are highly accurate and accuracy assessed, others are not. However, this report is not a project level assessment, **it is a broad-scale analysis of habitats, ranges, and existing and future conditions given management options.** *It is not appropriate to use this database/or project level analysis though many of the original vector components are appropriate inputs to such analyses.* Finally, it is important to point out that regardless of the inherent accuracy or appropriate use of these data, the purpose of this database was to provide a consistent analysis of options for comparative purposes.

Other Efforts To Build Regional Data Sets

Interagency Scientific Committee

In assessing the efficacy of applying regional data sets to resource problems and determining future needs, **it is valuable to briefly review other, similar, efforts.** The Interagency Scientific Committee did not employ the use of geographic information system technology directly. While many of the maps and data used in this effort were generated from data contained within agency geographic information systems, the team did not use technology directly. Maps were assembled relating to the northern spotted owl, vegetation, etc. Manual comparisons of these were made by members of the Interagency Scientific Committee. While this type of analysis can be effective, the labor- intensive nature of the process often precludes extensive analysis.

Scientific Panel on Late-Successional Forest Ecosystems

The Scientific Panel on Late-Successional Forest Ecosystems was one of the first efforts to build and utilize geographic information system technology for broad-scale analysis. This effort was unique in many ways and serves as an example of one possible approach to developing an information base for informed decisionmaking. Several committees from the U.S. House of Representatives commissioned four scientists to assemble alternative management options for consideration in determining the management of the remaining late successional and old growth ecosystems. To do this, the scientists enlisted the help of over 180 specialists from several federal and state agencies over a period of approximately 1 week. A large conference facility in Portland was rented for this effort, and under the direction of the four scientists, these specialists proceeded to develop maps of late-successional and old-growth forest ecosystems. Maps depicting vegetation, Habitat Conservation Areas and known locations of northern spotted owls were integral to the effort in designating significant areas of late-successional forests and management options.

Specialists delineated four categories of information: Most Significant Late- Successional/Old-Growth (LS/OG1), Significant Late-Successional/Old-Growth (LS/OG2), Owl Additions, and Key Watersheds. Members of the Interagency Scientific Committee were present and reviewed the maps of the Most Significant Old-Growth (referenced as LS/OG1 in the report). These maps were critically reviewed using the criteria set forth in the Committee's findings. If the LS/OG1 network did not meet the criteria outlined in the Interagency Scientific Committee report, additional areas were identified that, coupled with the LS/OG1 areas, met the standards in the report. These areas are defined as Owl Additions. The final map information developed during this effort was called Key Watersheds and represented areas containing potentially threatened fish stocks or particularly high quality habitat. The development of the **LS/OG** areas, Owl Additions, and Key Watersheds was a significant contribution to all concerned and were used extensively in the development of this report.

While considerable information regarding spotted owls was assembled or collected during this effort, little information was available or collected regarding other species associated with late-successional forest ecosystems. As a result, the primary use of geographic information system technology during this effort was in producing hard copy maps and for the calculation of timber volumes resulting from alternative land use options. Geographic information system

technology was not utilized to the extent **it** has in this process in providing a range of analyses. The data have been used to some degree recently since **it** has become available and is utilized extensively in this analysis as well as by interest groups.

Northern Spotted Owl Recovery Team

One of the major challenges in developing the draft Northern Spotted Owl Recovery Plan was assembling data from three states and a variety of ownerships. These data included information about forest vegetation, suitable owl habitat, a spotted owl range map, forest productivity, owl locations, land ownership, land allocations, streams, locations of variety of other species, critical habitat designations, physiographic province boundaries, and a variety of possible conservation strategies. These data were installed on a geographic information system and used to produce the considerable information used to develop the draft recovery plan.

This data base was the first multiownership, multistate data base developed for spotted owls and their habitat. The Northern Spotted Owl Recovery Team was the first group to bring together information on spotted owls and other key attributes into one regional geographic information system database; their efforts built from the initial database developed for the critical habitat designation process begun by the U.S. Fish and Wildlife Service and utilized information contained in systems maintained by the states. The data base took two years to develop. The Recovery Team's data base served as the starting point for the Forest Ecosystem Management Assessment Team's efforts.

Forest and District Planning

Both the Forest Service and Bureau of Land Management utilized, to some degree, geographic information system technology in their ongoing efforts in resource planning.

Forest Service

The Forest Service administers the most forested land of any agency within the area addressed by this study. It is by far the largest federal land management agency represented here and, in many ways, presented the biggest obstacle in the development of this information resource. This situation was not by design or lack of foresight though many may argue to the contrary. Rather, **it** is an artifact of a number of factors, namely past Congressional and Administration direction or lack of direction, implementing regulations, and agency culture. The National Forest Management Act (1976), requires the Forest Service to conduct analyses and produce forest plans for each Forest within a prescribed time frame and with specific objectives. Implementing regulations faithfully prescribed a process for conducting these analyses and producing the needed plans. The focus of the forest planning process was aimed at the administrative unit known as a National Forest.

Each Forest in the National Forest System established a Forest Planning Team, an interdisciplinary group of resource specialists who analyzed current conditions, conducted public scoping, and developed alternative plans for management of a particular Forest. Upon completion of this process, the decisionmaker, generally the Regional Forester, chose one option with or without modification and a Record of Decision was signed. The majority of National Forests have completed this process once and some are well into the next round. Agency direction for development of these plans comes from both the Washington Office of the Forest Service and the Regional Offices.

As implemented in the Pacific Northwest, efforts to develop forest plans are generally centralized in the Supervisor's Office of each National Forest. Databases were developed specifically for this task, often separate from other analytical processes ongoing within the Forest, both in the Supervisor's

Office and at the Ranger District level. If information processes on the Forests do not recognize this, and many do not, there is significant opportunity for these different data sets to become increasingly in disagreement especially because the forest planning process can take years to complete. The net result is obvious: Forest Plans are developed on one set of data while other data sets at Forest and District levels work off of others. Most Forests recognize this problem and have taken or are taking corrective action.

To complicate matters further, the forest inventory process is coordinated Regionally and is designed to support the forest plan efforts. These inventories, while coordinated, have not been consistent between Forests and are rarely implemented as base information for use in project level planning. The Pacific Northwest and Southwest Regions have made considerable effort in standardizing inventory mapping and data collection techniques, but again, these data may or may not form the basis of planning at all levels within the Forests themselves or between Forests, even between those with coincident boundaries.

Bureau of Land Management - Oregon State Office

The Bureau of Land Management, since 1986, has been developing the Western Oregon Digital Database in support of its Resource Management planning process on 2.4 million acres. Bureau of Land Management Districts are analogous to the Forest Service National Forests in terms of administrative hierarchy but resource planning is coordinated, including database development, at the State Office for areas in Western Oregon. While this database covers only western Oregon, it does provide a set of consistent data for forested lands administered by the Bureau of Land Management in all of Oregon. Issues of coding, scale detail, etc. only had to be dealt with once for lands within the Oregon State Office database. However, little data were available on Bureau of Land Management administered lands within California and eastern Oregon and Washington, which presents the same problems encountered with Forest Service data.

The Western Oregon Digital Database and the Bureau of Land Management's planning process represent a commendable effort in developing resource management plans based on geographic information system-based spatial analysis. It is based on a database containing information regarding more than 65,000 forest stand polygons collected over the past 30 years. While the Western Oregon Digital Database project is not a prototype example of building a database for ecosystem management, it is an excellent example of an integrated spatial database. It is good because it is the repository of information that the field professionals must use. They have a direct interest in maintaining and updating this information. If geographic information systems and other information technologies are to be a timely and informative tools for ecosystem management, the data collected must be integral to the daily work of the professionals responsible for the resources at the project level. The same data should be integrated into planning and analysis processes at broader scales.

Because the Bureau developed a coordinated Resource Management Plan for all of western Oregon, the same issues regarding consistency in planning efforts within the Forest Service are not as acute. However, no substantive efforts have been made to provide consistencies between the agencies even though ownership is mingled and information needs are nearly identical. The issue is not purely one belonging to the individual agencies. There has been little direction provided from either Congress or the Administration in past years to pursue this activity, and often past direction has precluded any efforts initiated by either agency.

Consistency in natural resource information is not an issue applicable to just the Forest Service and Bureau of Land Management. All land management or regulatory agencies with interest in the forests of the Pacific Northwest have responsibility for this issue. Finally, none of the federal agencies have any significant data available to them on private lands intermixed or surrounding their own. In many cases, laws and regulations prevent federal agencies from collecting data on lands other than those they manage. While **it** may be a more difficult issue than with public lands, ecosystem management concepts in their purest form, like species, do not usually distinguish public from private lands. It would be useful to be able to assess the entire landscape, at least in analyzing existing conditions.

Survey of Agency Personnel

For this project, it was desirable to determine what information standards exist or are under development and to find out what recognition of need exists within the federal land management and regulatory agencies. To that end, approximately 100 individuals representing a cross section of agencies, specialties, and organizational levels were surveyed. Questions regarding existing and impending standards, the need for standards, the scope of standards, etc. were sent to personnel in the Forest Service, Bureau of Land Management, National Marine Fisheries Service, U.S. Fish and Wildlife Service, National Park Service, and the Environmental Protection Agency. The responses were used in the development of the Implementation and Adaptive Management chapter and this appendix and are available for further review. The range of responses was large and somewhat, though not always, predictable and are certainly a useful tool in assessing the current situation and validating ideas contained here.

In short, there is an almost unanimous agreement on the need for standardization of basic resource information, but a variety of opinion exists on what degree of standardization is needed at various levels. There is also varying opinion on how to achieve that objective and whether it should be mandated. About half believed that standards must be mandated and the other half didn't believe that a mandate would work or was necessary. There was general agreement that standardization should build on efforts already under way or established with some recognition that not everyone would be satisfied. One of the largest concerns expressed related to allowing sufficient flexibility to accommodate local needs. This is, perhaps, an artificial barrier. Standards should be hierarchical with careful consideration given to precisely identifying what information needs to be standardized at what level. In general, as one moves through the hierarchy of analysis needed at any given level, the detail of information required should increase (e.g., detail needed is less at the regional level than at the project level).

It would be impractical to determine standards for all data collected at every level and would significantly impact the time required to develop them.

Issues and Opportunities

Common Data

One of the key issues then in establishing ecosystem management as an overriding policy is the establishment of this core of information. While not a new issue to any of the federal agencies, discussions between agencies have occurred several times over the last few years regarding issues and opportunities to identify common information structures and collection processes. These efforts have rarely come to fruition except when clear direction has been established or where standards and methodologies exist or where one agency took a lead role and others simply built on what was stated.

A good example of an agency taking a lead role involves the collection of elevation data. The U.S. Geologic Survey has responsibility for these data, and for several years the agencies involved in land management have been working cooperatively to collect and maintain a single set of elevation data. The cost savings to the agencies and ultimately to the taxpayer are significant because there are no redundant efforts now in place to collect elevation data for the same land areas. This cooperation is now being extended to include state agencies, and soon Region-wide availability of elevation data collected to the same standard and maintained in the same format will be available. This type of effort is clearly needed for other data as well.

Another type of cooperative effort exists in the Pacific Northwest as well as in other parts of the country. In 1989, in the Pacific Northwest, the U.S. Geological Survey established an interagency group known as the Northwest Land Information System Network. At the heart of this group is an interagency memorandum

of understanding that has been signed by the regional heads of over a dozen federal and state agencies. The primary benefit to date has been an ongoing effort to share information about relevant activities of the member agencies. Through this group, a database containing information on spatial data available from each of the member agencies has been designed and is now being implemented through the respective states. While not complete, there is tremendous opportunity and need for this resource. Another extremely valuable outcome of this effort is an agreement between member agencies to share information. Through the network, member organizations are able to acquire information from others with little or no cost except where mandatory by agency regulation or law.

Maintenance of Data Versus the Short-Term Approach

Another issue is the establishment of databases without a commitment to maintain them. Several times over the past few years, databases have been assembled to meet some objective or direction with no accompanying direction or funding to maintain them. Databases have been established by the Forest Service, Bureau of Land Management, and the U.S. Fish and Wildlife Service specifically dealing with the northern spotted owl and related information. However, no clearly defined strategic plan has been established for any of these efforts to update, maintain, and share these resources even though it is fairly clear that it would be advantageous to do so. For example, the Forest Service, Bureau of Land Management, and the U.S. Fish and Wildlife Service all maintain databases on northern spotted owls including location information. The agency with responsibility for determining which of the owl locations is in the "official data set, is the Fish and Wildlife Service, yet the "official data set is not routinely shared with the land management agencies. The inefficiencies and potential problems this can cause are easy to imagine.

In 1989, Congress directed the Forest Service to inventory old-growth forests in the Pacific Northwest on National Forest System and National Park Service lands because there was no definitive information on the issue. It would have been extremely efficient to include Bureau of Land Management lands in this inventory, which would have provided a consistent information source for nearly all federally owned forest lands -- but the budget direction precluded this opportunity. Also, there was no direction on the long-term maintenance of the information even though, 4 years later, the issue is far from resolved. Appropriation legislation and other governing laws and implementing regulations are so specific and have so many requirements that even if the motivation were high to establish more cooperative efforts, the barriers to doing so are often insurmountable.

Technology Versus Information

In solving some of the information puzzles facing us, it is often tempting to focus on the technology rather than the information. Responses to the survey indicated a number of managers, researchers, specialists and technologists felt that common tools were key in achieving an ecosystem management. However, many others recognized that the real key is not the lack of similar hardware and software, but rather having consistent information. While it would certainly simplify matters if everyone had the same technology available, it would be of little benefit if information from the different agencies remains incompatible. So long as acquisitions adhere to established federal information processing standards, differences in hardware, software, communications, and data formats can be resolved. Differences in information standards, however, require huge investments in time to resolve, if they can be resolved at all. Even where differences in information can be resolved, the effort often requires a significant loss of information in the process.

Artificial Barriers/Agency Culture

In an environment with inadequate national, regional, and agency policies regarding the establishment of information resources and confusing laws and regulations having an effect on information standards, it's hardly surprising that field managers find it difficult to support agency and interagency efforts to establish them. Resource managers and specialists have been collecting and maintaining information for years. Many have done a remarkable job considering that most of these people have had little, if any, training related to information management, geographic information systems, remote

sensing, and other information technologies. An artifact of this situation, however, is that many resource specialists and managers are reluctant to give up processes that have met their local needs. This approach was adequate when resource issues were primarily local. Over the past decade, issues of local concern have shifted to ones of regional or national scope. Districts and Forests are no longer in a position to analyze many of these issues because the scale and scope has changed. It does not mean the issues no longer concern them. Rather, they can no longer resolve them independently of other land holders, administrative units, or agencies. Ecosystem management recognizes this situation and can provide a framework for dealing with them.

Often land managers' performances are measured by how well targets are met, usually for commodity items (e.g., timber volume) that are ultimately set by Congress and signed into law by the President. This process is clearly defined and accountability is established from the top down. Everyone involved understands what is expected and the measures used to monitor performance. Rarely are these people held accountable for the efficiency with which they manage information or how compatible it is with data collected by other managers either horizontally or vertically within an agency. Similarly, agencies are not generally held accountable for how well information from their agency compares with those with similar interests.

Conclusion

The collection, maintenance, analysis, and sharing of information is an integral part in virtually everything the resource management and regulatory agencies do. This will especially be the case in ecosystem management. The degree of effectiveness with which land managers perform this task has significant implications on the quality of the work they perform and the cost effectiveness with which they do it. It is hoped that the conclusions and recommendations will serve to highlight the issues and at least provide a starting point for all concerned to begin to work together and resolve the critical issues related to resource information management.